SONY *Training Manual*

KV-36HV500

KV-57WV700

Direct View/Projection Television Troubleshooting

DA-4 & DA-4X Chassis

Models:	DA-4	DA-4X
	KV-32HS500	KP-57WV600
	KV-32HV600	KP-57WV700
	KV-34XBR800	KP-65WV600
	KV-36HS500	KP-65WV700
	KV-36XBR800	
	KV-40XBR800	

Theory of Operation & Practical Troubleshooting Tips

Course: C31P15

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Chapter 1 - Introduction and DA-4 & DA-4X PCB Interconnection

Introduction

Overview

The C31P15 course covers the DA-4 (Direct View) and the DA-4X (Projection) chassis. The content includes new features such as Memory Stick and DVI. Also included is theory of operation and troubleshooting tips for all major circuits (Power Supplies, Protection, Deflection, Communications and Audio) in the DA-4 and DA-X chassis. This training manual is based on the KV-32HV600 model.

Objectives

- New Features
- Circuit Theory of Operation
- Component and Board level troubleshooting

DA-4 & DA-4X PCB Interconnection

Overview

The DA-4 (Direct View) and DA-4X (Projection) chassis share many of the same PCBs. The only differences are found in the RGB Drive, Power Supply and Flash Focus circuits. Table 1-1 indicates the circuits found on each PCB and if the PCB is board or component level repairable for both the DA-4 and DA-4X chassis.

Table 1-1 DA-4 & DA-4X PCB Circuits and Repair Information

Board	Circuits (DA-4)	Circuits (DA-4X)	Field Reparability	Comments
A	• A/C Input • STBY 5V PS • +9V Reg. • +3.3V Reg. • +5V Reg. • Main & Sub. Tuners • Audio Output IC's • DY-Conv.	• A/C Input • STBY 5V PS • +9V Reg. • +3.3V Reg. • +5V Reg. • Main & Sub. Tuners • Audio Output IC's	Possible Component Level Repair	No DY-Conv. Circuit for DA-4X Chassis
AD	• N/A	• Flash Focus • Picture Centering • 5V Reg.	Board Level Repair	DA-4X chassis ONLY

B	• H-Protect • V-Protect • AD-DRC • MID-XA • HD-ADC • CRT Drive • A/D DNR • Differential Input (Memory Stick®) • +1.8V Reg. • +2.5V Regs. • +3V Reg. • +3.3V Reg. • +5V Reg.	• H-Protect • V-Protect • AD-DRC • MID-XA • HD-ADC • CRT Drive • A/D DNR & SRAM • Differential Input (Memory Stick®) • +1.8V Reg. • +2.5V Regs. • +3V Reg. • +3.3V Reg. • +5V Reg.	<u>Board Level Repair</u>	Additional Circuits on DA-4X chassis: • Extra VM circuits • D-Brd RGB connections • SRAM (IC3001)
C	CH (HS) or CX (HV/XBR) • RGB Drive	CR, CG, CB • RGB Drive	Possible Component Level Repair	Separate RGB drive boards in DA-4X chassis
D	• H & V Drive • H & V DY • Main Power Supply +/-15V +7V +5V +11V +12V +200V +33V Heater • HV Power Supply • Protection Circuits HV Protect +135 OVP/OCP HD Protect IK Protect	• H & V Drive • H & V D • HV Drive • Convergence Amps • +12V Reg. • +5V Reg. • +210V • +135V • Heater • Protection Circuits HV Protect HD Drive +135 OVP/OCP	Possible Component Level Repair	Main Power Supply located on D-Brd in DA-4 chassis. Main Power Supply located on G-Board in DA-4X Chassis

DH	• N/S Correction • E/W Correction	• N/A	Possible Component Level Repair	KV-40XBR800 ONLY
G	• N/A	Power Supply • Unreg. 7V • Unreg. 5V • +/- 15V • +/- 19V • +135V • +33V • +12V • +36.5V • RY6701 • RY6702	Possible Component Level Repair	DA-4X chassis ONLY
HA	• Key Input • LED • Remote Control	• Key Input • LED • Remote Control	Possible Component Level Repair	All models and both Da-4 and DA-4X chassis Different Part# for DA-4 & DA-4X
HC	• Key Input • LED • Remote Control	• N/A	Possible Component Level Repair	XBR models ONLY
HB	• Front Video Input	• Front Video Input	Possible Component Level Repair	All models and both DA-4 and DA-4X chassis Different Part# for DA-4 & DA-4X
HM	• Memory Stick® • Terminal Board	• Memory Stick® Terminal Board	Board Level Repair	All models and both DA-4 and DA-4X chassis's Same Part# for both DA-4 & DA-4X
M	• Main System Control • A/V Processing • 3D Comb Filter • 5V Reg.	• Main System Control • A/V Processing • 3D Comb Filter • 5V Reg.	Board Level Repair	All models and both DA-4 and DA-4X chassis Different Part# for DA-4 & DA-4X

MS1	• Memory Stick® Processor	• Memory Stick® Processor	Board Level Repair	All models and both DA-4 and DA-4X chassis's Different Part# for DA-4 & DA-4X
SR	• N/A	• Flash Focus Sensor	Board Level Repair	DA-4X chassis ONLY
U	• A/V Switch Terminal board	• A/V Switch Terminal board		All models and both DA-4 and DA-4X chassis Same Part# for both DA-4 & DA-4X
UD	• DVI Decoder	• DVI Decoder	Board Level Repair	All models and both DA-4 and DA-4X chassis Same Part# for both DA-4 & DA-4X
VM	• N/A	• Velocity Modulation	Possible Component Level Repair	DA-4X chassis ONLY
W	• Velocity Modulation • Vertical Pincushion • N/S Correction	• N/A	Possible Component Level Repair	DA-4 chassis ONLY

Figure 1-1 illustrates the PCB interconnections for both the DA-4 and DA-4X chassis.

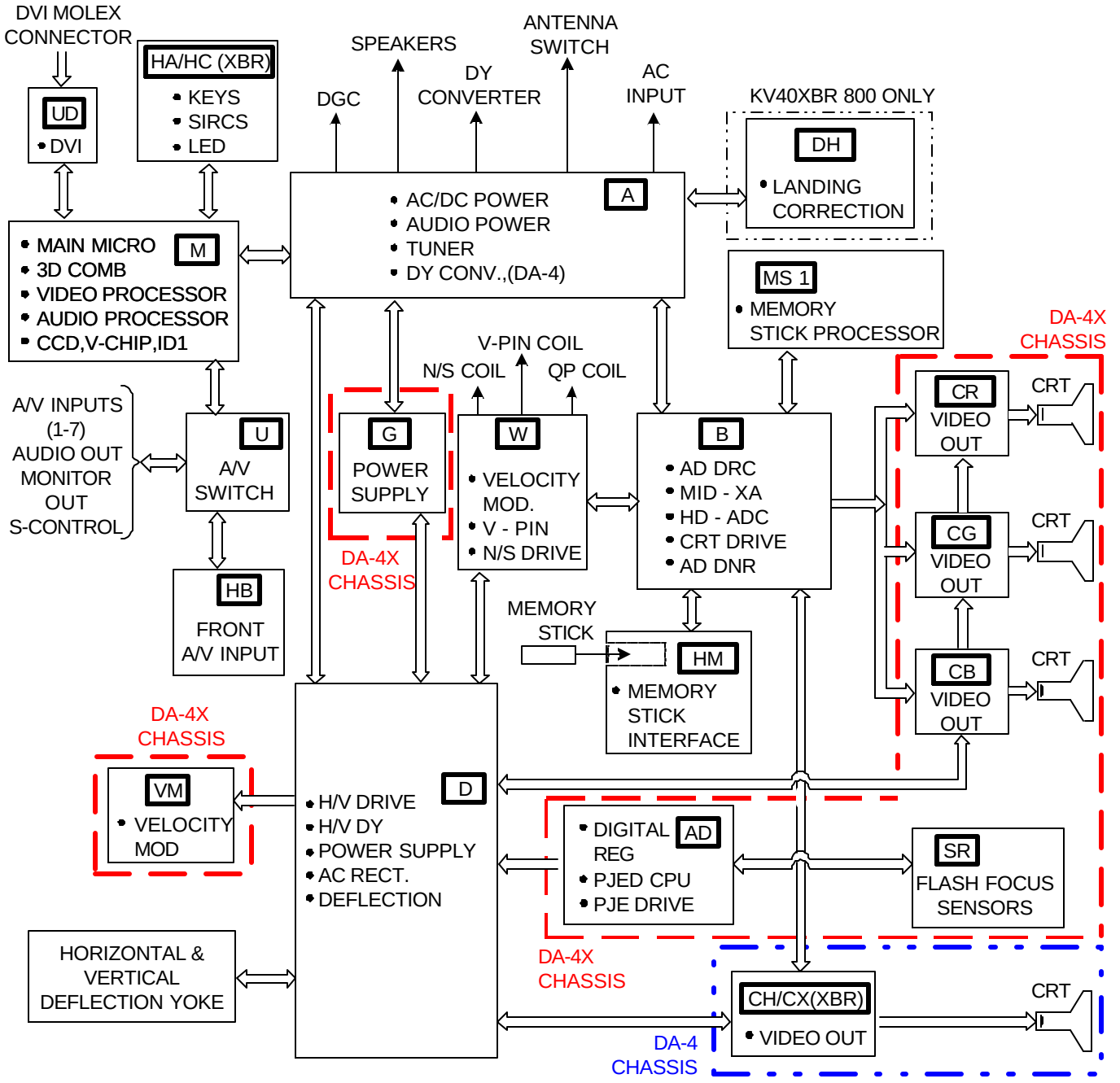


FIGURE 1-1 - DA-4 & DA-4X PCB BLOCK INTERCONNECTION DIAGRAM 1C31P15 1478 11/7/02

Chapter 2 - New Features (DA-4 & DA-4X Chassis)

Three new features will be discussed in this section:

- Scrolling Index
- DVI Interface
- Memory Stick® Interface

Scrolling Index

The Scrolling Index allows you to select your main video from a scrolling index of video pictures.

The Scrolling Index appears with the currently selected program in the main (left) window and four scrolling video pictures in windows down the right side of the picture tube.

As each picture on the right scrolls to the live preview window, it changes briefly from a frozen video to live video. The right side continues to scroll through the entire channel list.

Figure 2-1
Scrolling Index

Factors Affecting the Scrolling Index:

- **Scrolling Index does not function if you use a cable box to view all channels.**
- **Sources connected to the AUX, Video 5, Video 6 and Video 7 inputs are visible in the left window, but not in the scrolling right windows.**
- **Scrolling Index does not function if the parental controls are set.**

Digital Visual Interface (DVI)

Introduction

As the digital display technology (e.g. Plasma and LCD) grows so does the need to replace the present analog HD component connection between external digital device (e.g. Digital TV/Satellite Receiver) and the HDTV™ set. The issue is the inherent picture quality problems caused by Digital-to Analog (D/A) and Analog-to-Digital (A/D) conversion processes.

For example, if you have a digital Plasma display HDTV™ and a Digital TV/Satellite Receiver, the digital video signal in the Digital TV/Satellite Receiver must be converted to a analog component video signal and then sent to the HDTV™ where it must be converted back to a digital signal video to drive the Plasma display. Because of the two video signals conversion steps and the possible analog signal loss across the connection between the HDTV™ and the Digital TV/Satellite Receiver, the picture quality will suffer. Even with an analog CRT the Digital TV/Satellite Receiver video signal must go through D/A conversion, which can adversely affect picture quality.

The resolution to this dilemma is the creation of a complete end-to-end standard digital video interface, such as DVI. The DVI interface is a high-speed digital video interface allowing uncompressed high-definition content to be passed to another DVI equipped device such as an HDTV™ set. DVI is the only digital interface capable of

accommodating uncompressed digital data such as HD video. DVI also has the bandwidth to support higher audio fidelity.

DVI has a bandwidth of up to 5 Gigabits/sec, which is more then enough to accommodate an uncompressed HD video transmission that typically requires 2.2 Gigabits/sec bandwidth.

DVI Connector and Decoding Block

The DVI Molex connector and Decoding circuitry for both the DA-4 and DA-4X chassis are located on the UD-Board (**NOTE: This board is NOT field repairable).** Figure 2-2 shows a block diagram for the UD-Board. The DVI signal (from a Digital TV/Satellite Receiver) is received at the 24-pin Molex connector CN7001. There are three serial data differential channels RX0+/RX0-, RX1+/RX1-, RX2+/RX2- and one reference clock differential channel RXC+/RXC-.

IC7001 NVM is also connected to the external device through the SDA and SCL (I2C) bus. IC7001 stores the EDID data (Extended Display Identification Data) and HDCP (High Definition Digital Content Protection).

EDID is sent to inform the external digital device of the TV's identity and capabilities.

HDCP is an Authentication protocol between the external digital device (transmitter) and the TV (receiver) that affirms to the transmitter that the receiver is authorized to receive the protected information.

CN 7001/pin 14 (5V) is supplied from the external digital device to power IC7001 (NVM) so EDID can be sent when the TV set is OFF. If the TV set is ON, IC7001 will receiver 5V from CN7002 through D7001.

CN7001/pin 16 is the Hot Plug Detect pin (HPD). The TV set supplies 5V to the external digital device to verify proper connection between the two devices.

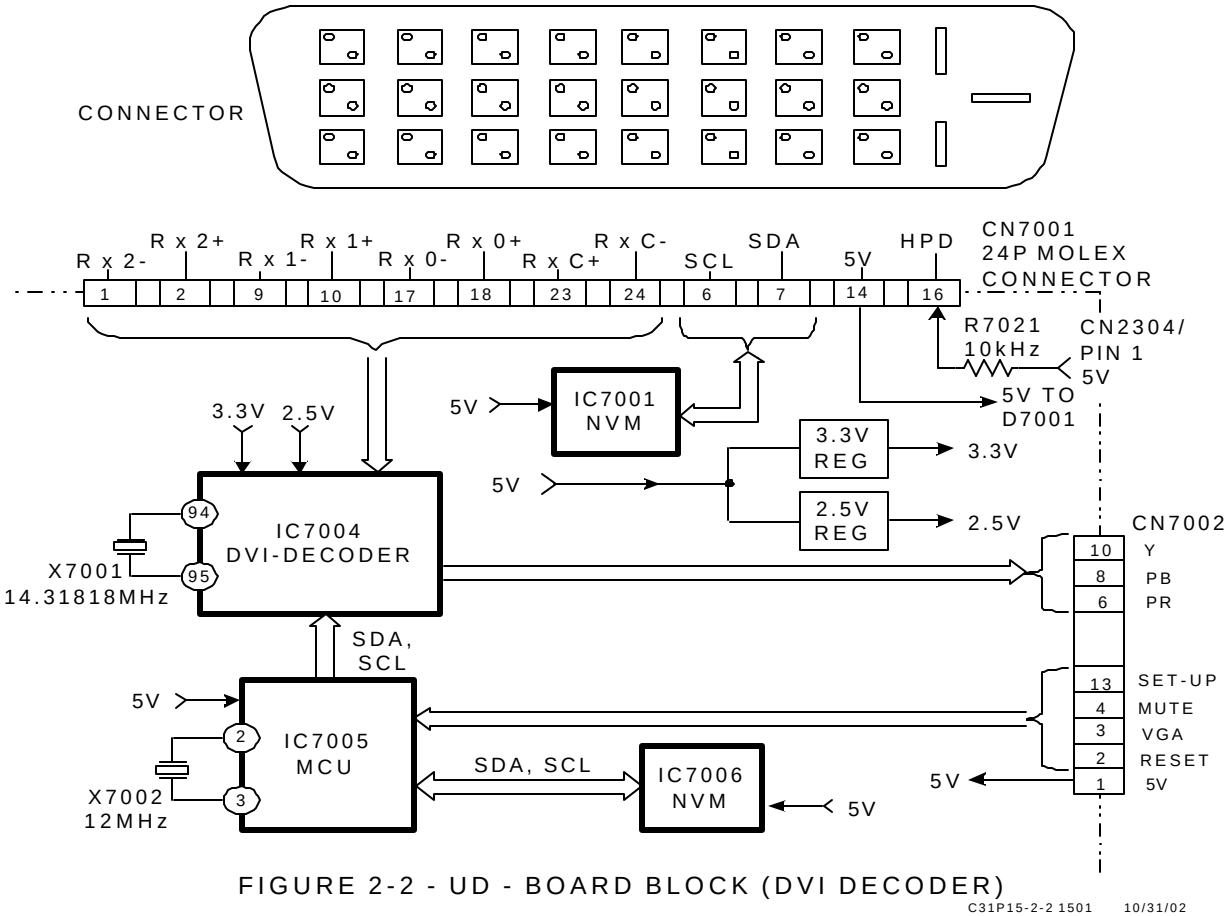


FIGURE 2-2 - UD - BOARD BLOCK (DVI DECODER)

C31P15-2-2 1501 10/31/02

The DVI Decoder, IC7004 receives the three channels of digital video data and outputs analog component video (Y, PB, PR) to CN7002/pins 10, 8 and 6 respectively.

Memory Stick® Interface

Introduction

Memory Stick® is a new compact, portable and versatile **Integrated Circuit Recording Medium** with a data capacity that exceeds that of a floppy disk. The internal memory circuit structure is a type of Flash Memory similar to that found in a personal computer. It is a solid-state design, which basically means there are no moving parts. Inside the Memory Stick® is a grid of columns and rows with a two-transistor cell at each intersection point on the gird, which is used to store a 1 or 0. The Memory Stick® is specially designed for the exchange and sharing of digital data among Memory Stick® compatible products such as Digital Still Cameras and Digital Video Cameras. Because it is removable, Memory Stick® can also be used for external data storage.

Memory Stick® technology allows you to view on the TV digital (JPEG) still images that are stored on Memory Stick® medium. You can choose from an index of the images stored on the Memory Stick® or you can run a slideshow of those images.

The DA-4 and DA-4X chassis Memory Stick® viewer can display **ONLY Still Images** that have been recorded on Memory Stick® media by Sony brand digital still and video cameras.

Recorded images must meet the following specifications:

- Compression format: **JPEG**
- File format: **DCF compliant**

NOTE: Most Sony brand digital still and video cameras automatically record still images using DCF (**D**esign rule for **C**amera **F**ile system) **compliant directory and file names as shown in Figure 2-3:**

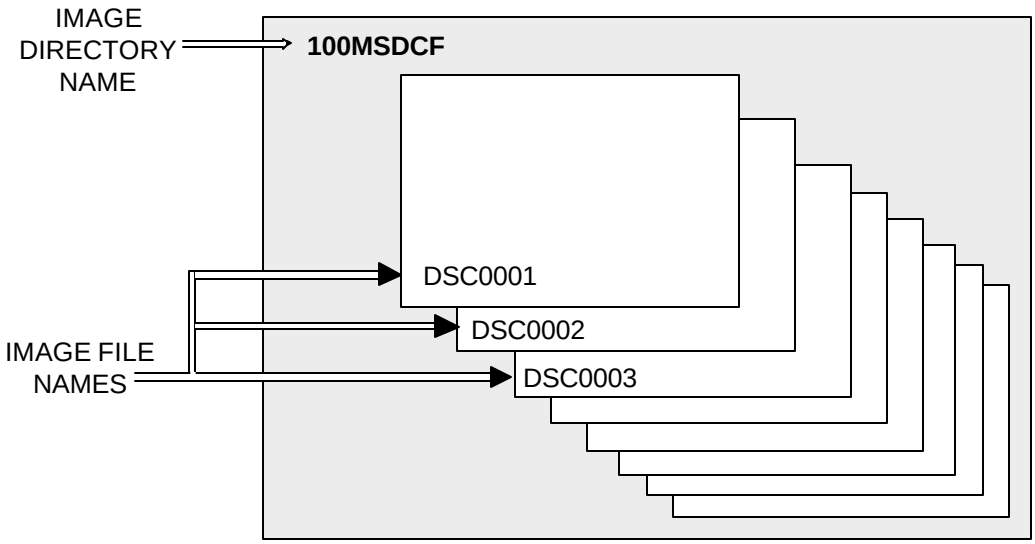


FIGURE 2-3 - DCF DIRECTORY C31P15-2-3 1504 9/26/02

The main advantage of the Memory Stick® is its size, which measures approximately 2''x3/4"x1/8", making it extremely portable (reference Figure 2-3). However, do not let the size fool you; the Memory Stick® comes in five data capacity ratings: 8MB, 16MB, 32MB, 64MB, 128MB and 256MB.

Note: The DA-4 and DA-4X chassis Memory Stick® viewer is compatible with Memory Sticks® up to and including 128MB. **The 256MB Memory Stick® is not compatible.**

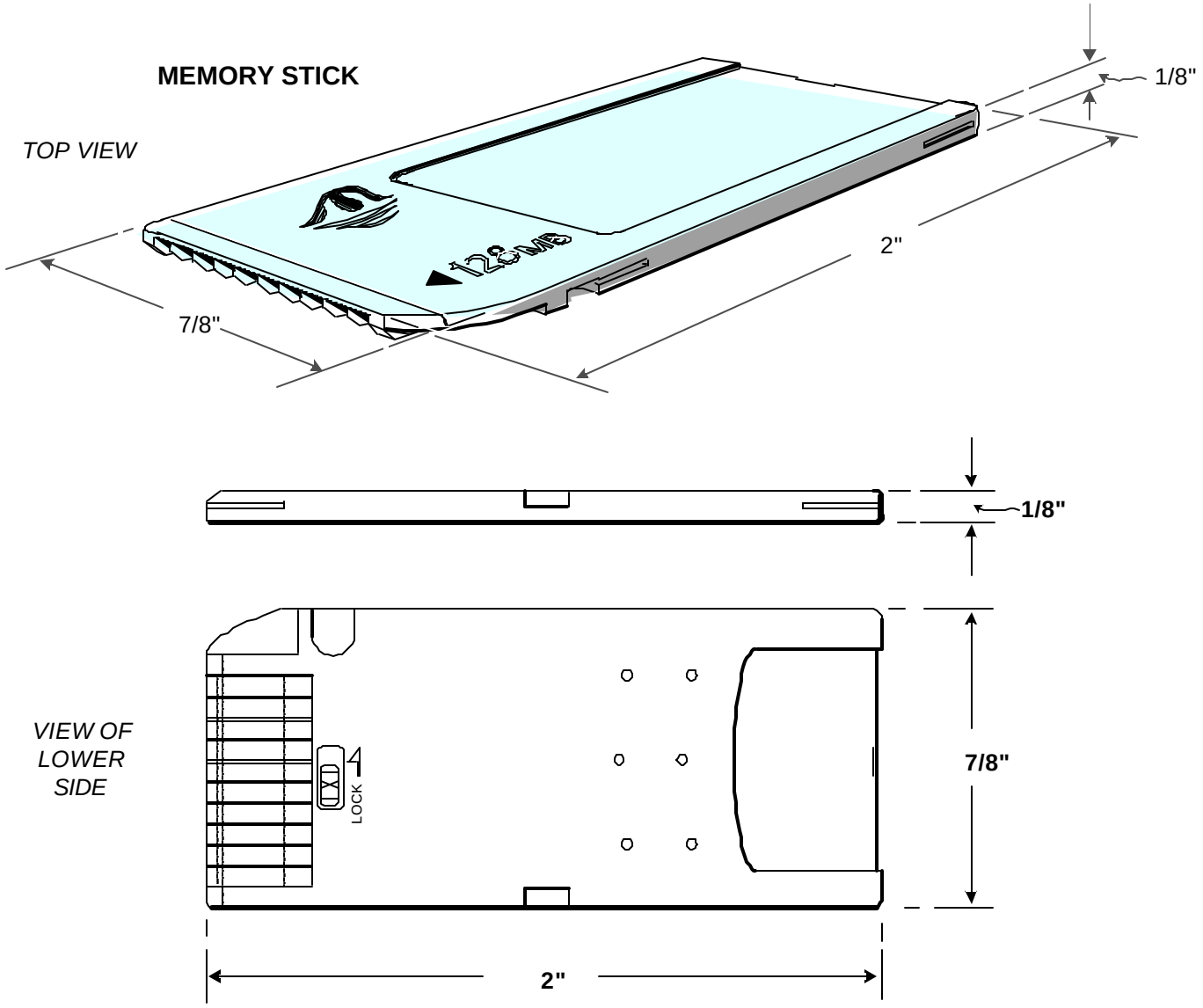


FIGURE 2-4 - MEMORY STICK DIMENSIONS C31P15-2-4 1505 9/16/02

The DA-4 and DA-4X Memory Stick® viewer cannot display any of the following:

- Images recorded on digital still cameras and digital video cameras that are not Sony brand.
- Images recorded using products that are not DCF complaint, including the following Sony products:
  - Digital still cameras DSC-D700
    DSC-D770
  - Digital video cameras DCR-TRV900
    DSR-PD100A
- Images stored on a Memory Stick® that has a capacity that exceeds 128MB.
- Images stored in TIFF or any other non-JPEG compression format.
- Images in directories that were modified or renamed on a computer.
- Images with less than 16 horizontal and/or vertical dots per line.
- Images with more than 4096 horizontal and/or vertical dots per line.

Memory Stick Interface and Processing Block

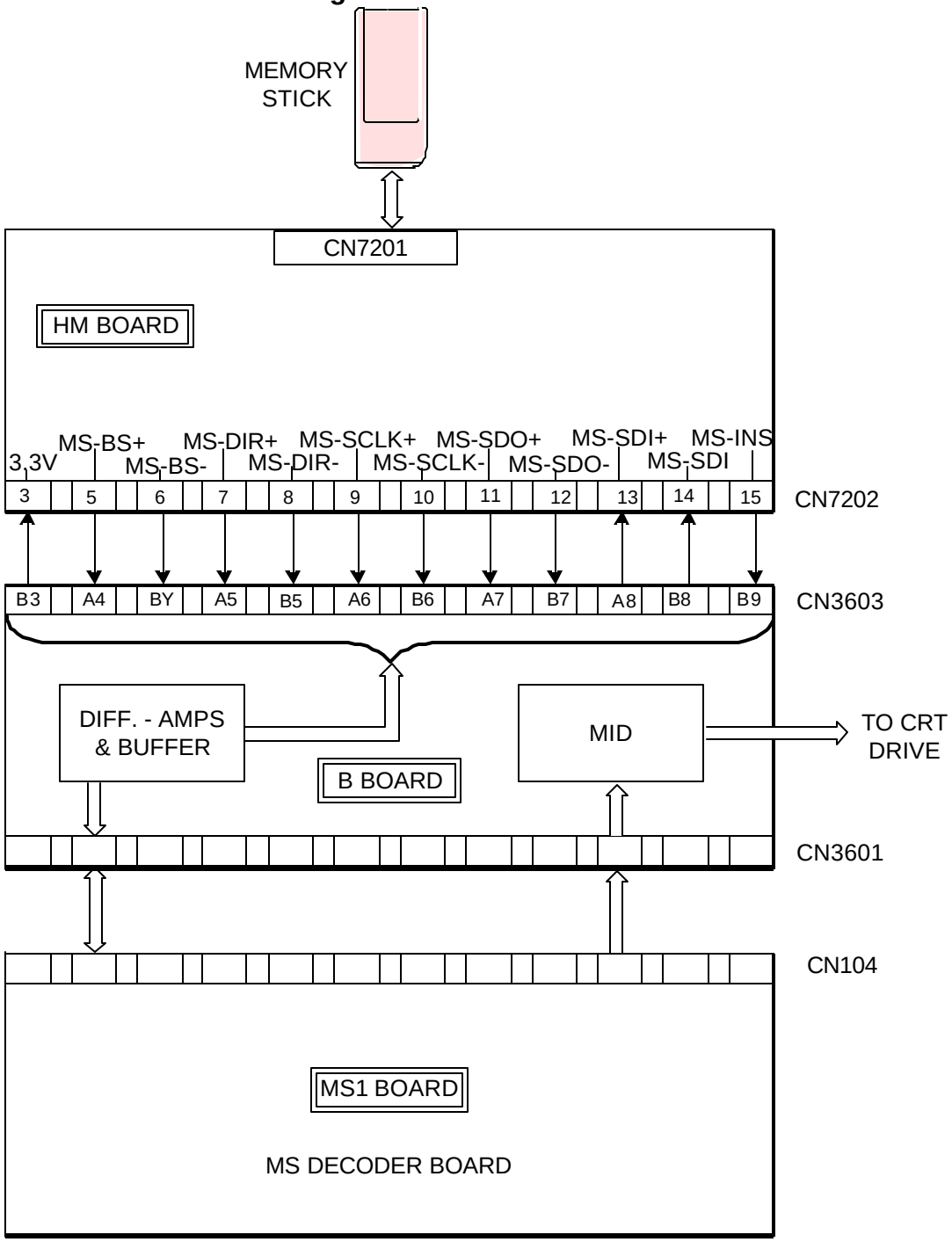
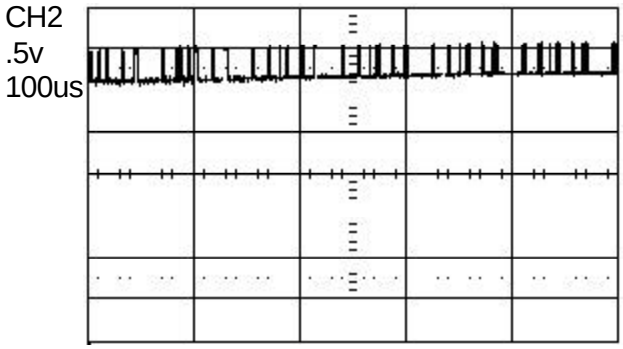


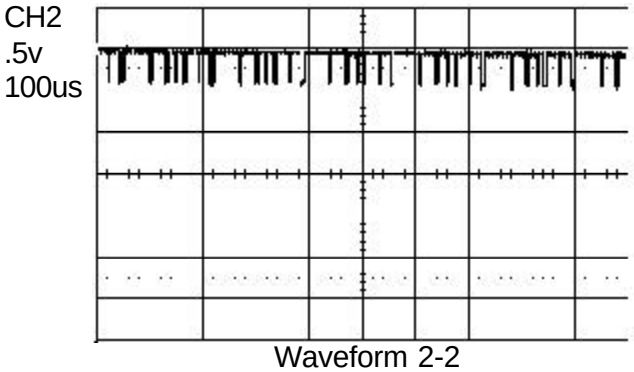
FIGURE 2-5 - MEMORY STICK INTERFACE & PROCESSING BLOCK

C31P15-2-5 1502 11/7/02

The Memory Stick® (MS) is inserted into CN7201 on the HM-Board. Once the MS is completely seated in the slot, the Memory Stick® applies a ground to CN7202/pin 15 (MS-INS), which goes Low **(from 3.3V to 0V)**. This notifies the MS1-Board that a MS has been inserted. Initial data will be transferred at this time between the HM-Board and MS1-Board and can be viewed at CN7202/pins 5 through 14 (reference Waveforms 2-1 and 2-2). The data signals are all in differential format with a positive and negative signal. The differential format is incorporated to eliminate noise on the data lines. Data can be viewed on these pins when the MS is initially inserted and when an image is selected for display on the CRT.



Waveform 2-1
MS - SDI (+)



Waveform 2-2
MS - SDI (-)

The MS-INS is applied to the B Board/pin B3 and forwarded on to the MS1- Board. The MS-Data signals are amplified on the HM-Board and then applied to the B Board/pins A4/B4 through A8/B8 where they are converted from differential format to single data lines, and further amplified and applied to the MS1-Board.

The MS1 Board performs the following functions:

- Memory Stick® System Control
- JPEG Processing
- Memory Stick Decoding

The Memory Stick® JPEG data is then converted into digital Y, CB, CR data on the MS1 Board. The digital Y, CB, CR data is then sent back to the B Board and is D/A converted to analog component video signals (Y, CB and CR), which drive the CRT.

Troubleshooting Tips

1) All three boards (HM, Band MS1) are **Not Field Repairable**.
2) Confirm CN7202/pin 15 (MS-INS) goes low when Memory Stick® is inserted.
3) Confirm CN7202/pin 3 (3.3V supply).
4) Confirm CN7202/pins 5 through 14 have data activity during the following two events:
    a. When the Memory Stick® is initially inserted; and
    b. When an image is selected for display on the CRT.
5) Confirm the voltages and signals in steps 2, 3 and 4 are applied to CN3603/pins B3, A4/B4 through A8/B8 and B9.
6) If all voltages and signals are applied to the B Board, further troubleshooting will be board swap due to inaccessibility to connectors on the B Board and MS1 Board.

There is not much signal processing performed on the B Board, so the most likely defect at this point would be the MS1 Board.

Chapter 3 - Power Supply (DA-4 & DA-4X Chassis)

This chapter will cover the power supply section for both the DA-4 and DA-4X chassis. The degauss circuit for the DA-4 chassis will also be discussed.

The power supplies for the DA-4 and DA-4X chassis are almost identical except in the following two main areas:

1) **High Voltage (HV) development:** The HV on the DA-4 chassis is Switch-mode power supply derived, whereas the HV on the DA-4X chassis is scan derived.
2) **Circuit Location:** On the DA-4 chassis, the power supply circuitry is located on the A and D-boards, whereas on the DA-4X chassis, the circuitry is on the A, D and G boards.

Except for the development of the HV, the circuit operation for the Standby 5V and Main Converter Power Supplies is identical. **Notes and references are placed on each diagram where the circuit operation is identical between the two chassis.** The circuit itself may be located on a different board and component reference numbers may be different, but the components are the same. As you read this section, note the similarities and differences between the DA-4 and DA-4X chassis.

DA-4 Chassis Power Supply

DA-4 Overall Power Supply Block

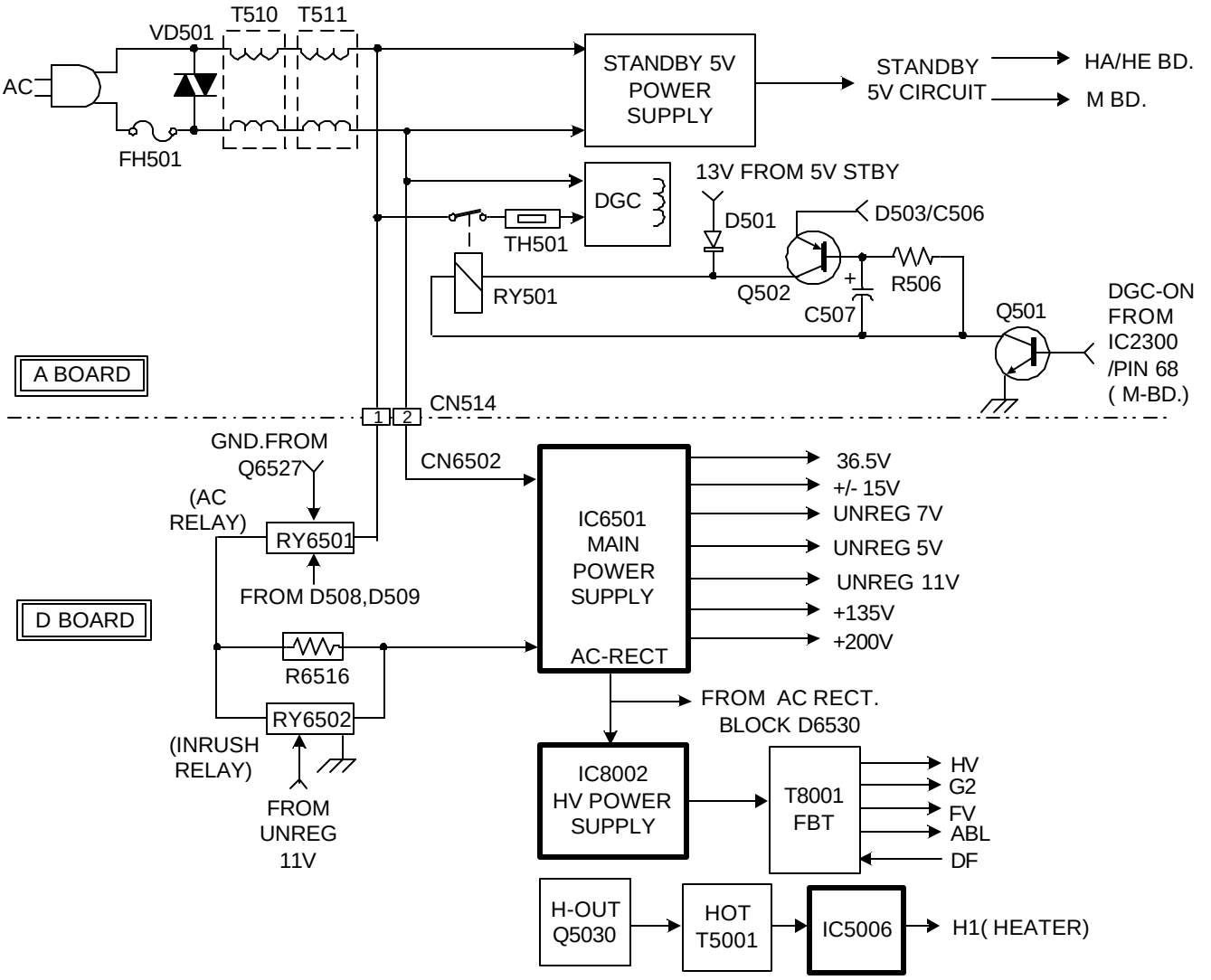


FIGURE 3-1 - DA-4 POWER SUPPLY OVERALL BLOCK C31P15-3-1 1509 10/28/02

DA-4 Overall Power Supply Block Description

Once 120V AC power is applied to the TV set (set plugged into the AC outlet), the **Standby 5V power supply** (located on the **A-board**) is active and outputs regulated 5V (reference Figure 3-1). The STBY 5V is sent to the M-board to partially power-up system control IC2300 and is also sent to the HA/HC board to power the Remote Control Sensor (SIRCS).

The **Main Converter power supply** (DA-4) located on the **D-board** is fed AC (from A-Board) through the AC-Relay (RY6501) and through Inrush-Current resistor (R6516). This limits the initial high current produced when the TV set is first turned ON. The Inrush-Current resistor (R6516) is removed from the AC input path using RY6501. Once the Main Converter power is up and running, the unreg11V output is fed back to RY6501, the relay switch is closed and R6516 is bypassed in normal operation. The Main Converter power supply outputs the following voltages:

- +/- 15V
- Unreg7V
- Unreg5V
- Unreg11V
- 36.5V
- +135
- +200

The **High Voltage (HV)** on the DA-4 chassis is developed using a switch-mode power supply identical to the one found in the Main Converter power supply except for the use of the Flyback (FB) T8001 as the output transformer (reference Figure 3-1). The HV power supply is located on the D-board. The HV power supply is activated simultaneously with the Main Converter power supply. AC power is fed to the HV power supply from the AC-RECT block (D6530), which also feeds the Main Converter power supply. The HV Converter output then drives the FB transformer, which outputs the following voltages:

- High Voltage (HV)
- Focus Voltage (FV)
- G2
- ABL

The **Heater Voltage** is scan derived using H-Out (Q5030), T5001 and IC5006 also located on the D-board.

The **Degauss Circuit** (reference Figure 3-1) will be activated after IC2300 (M-board) receives an ON command from either the ON/OFF button or the remote control, and after one of the following events have occurred:

- The AC power was disconnected (indicating that the TV was possibly relocated).
- The TV has been turned OFF for more then 15 minutes.

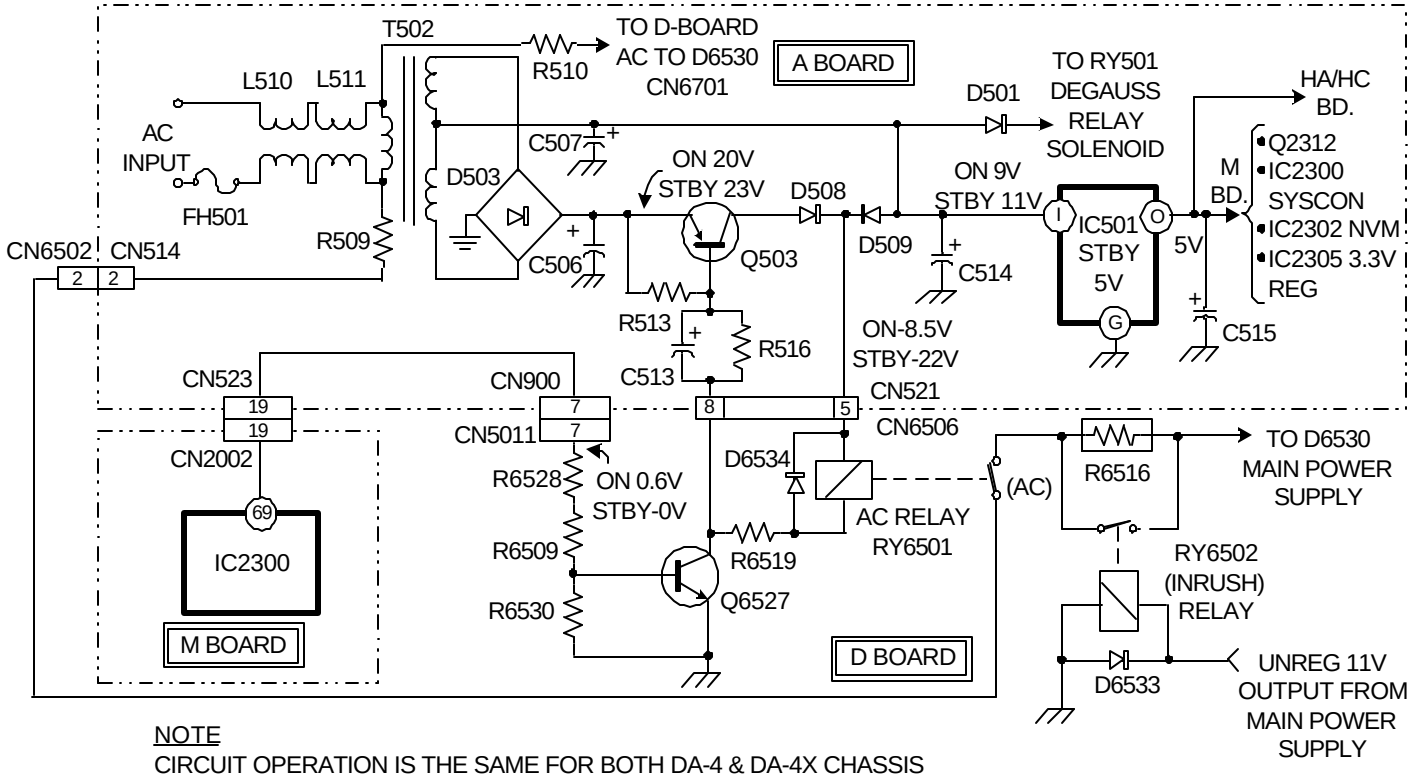
The base of Q501 receives a high from IC2300/pin 68 (turning Q501 ON). The ground path for the degauss relay RY501 and the base circuit of Q502 are completed through the collector/emitter circuit of Q501. Q502 supplies the initial kick voltage and current to RY501. Once C504 in the base circuit charges completely, Q502 will turn off and a hold voltage is supplied through D501 (13V) from the STBY Power Supply circuit.

RY501 switch closes and sends AC through the degauss coil, eliminating any magnetic fields present in the metallic parts in the picture tube, which could cause color purity problems. The degauss relay remains closed for approximately **six seconds** and then opens.

Three relay clicks will be heard when the set is first turned on in the following order:

1) Degauss Relay (RY501)
2) AC Relay (RY6501)
3) Inrush Current Relay (RY6502)

DA-4 STBY 5V Power Supply and Power-On Switching Circuit



NOTE
CIRCUIT OPERATION IS THE SAME FOR BOTH DA-4 & DA-4X CHASSIS

FIGURE 3-2 - DA-4 STANDBY 5V POWER SUPPLY & POWER ON SWITCHING CIRCUIT

C31P15-3-2 1508 11/12/02

Standby 5V Power Supply

Reference Figure 3-2 during the following circuit description:

The Standby Power Supply (located on the A-board) is operational as long as the set is plugged into an AC outlet. AC power is applied to T502 through fuse FH501 and chokes L510 and L511. T502 couples the AC across to D503 rectifier block and filter capacitor C507 (AC is also coupled to Q503; this is part of the power-on switching circuit which will be discussed next).

The **Standby 5V** power supply is a simple conventional full-wave (only two diodes in D503 are used) rectifier circuit. The resulting DC voltage (11V) is applied to the input pin of IC501 (5V regulator), which then supplies regulated 5V to the following components:

- **IC2300 System Control (M-board)**
- **IC2302 NVM (M-board)**
- **IC2305 3.3V Regulator (M-board)**
- **Q2312 Remote Input Buffer**
- **HA/HC boards (Key Input, LED and Remote Sensor)**

Power-ON Switching Circuit

Reference Figure 3-2 during the following circuit description:

In the Standby mode, System Control (IC2300) is partially powered (using STBY 5V) and waiting for an ON command from either the Front Panel Controls (IC2300/pins 93 and 94) or the Remote Control (IC2300/pin 7).

Once the ON command is received, IC2300/pin 69 (AC_RLY) outputs a high, which is applied to the base of Q6527 (turning Q6527 ON). This completes the ground path for the AC Relay (RY6501) and for the base circuit of Q503.

Q503 turns on and supplies the initial kick voltage and current through D508 to RY6501, closing the relay switch and supplying AC power to the Main Power Supply through Inrush resistor R6516 and D6530. Once C513 in the base circuit charges completely Q503 turns off; D508 reverse biases and D509 forward biases, supplying a hold voltage (9V) to keep the relay switch closed in the ON mode.

At this point the Main Power supply is turning ON (operation will be discussed next). The initial AC power to the Main Power Supply is through **Inrush resistor R6516**, which limits the high surge current that occurs momentarily at turn ON. Once the secondary voltage UNREG 11V is developed on T6502 in the Main Power Supply, it is fed back to the **Inrush Relay (RY6502).** RY6502 turns on and bypasses R6516 in the ON mode. R6516 is only in the circuit during initial power-up of the set.

Troubleshooting Tip:

Obviously, if a failure occurs in the 5V Standby Power Supply the unit will not even attempt to turn ON. If this condition occurs, check the following components:

1) FH501
2) 13V at IC501 Input Pin (I). If missing, suspect T502, D503 and/or C507.
3) 5V at IC501 Output Pin (O). If missing, suspect a defective IC501.
4) NOTE: Q503 is used as a current source for the AC relay (RY6501). If the collector/emitter junction of Q503 becomes an Open circuit, the set will still turn ON (using voltage through D509) and function properly with sufficient AC power input. If the AC power input is weak (Low Voltage ~90VAC, the unit will have difficulty turning ON without Q503 functioning properly.

DA-4 Main Switching Power Supply Circuit

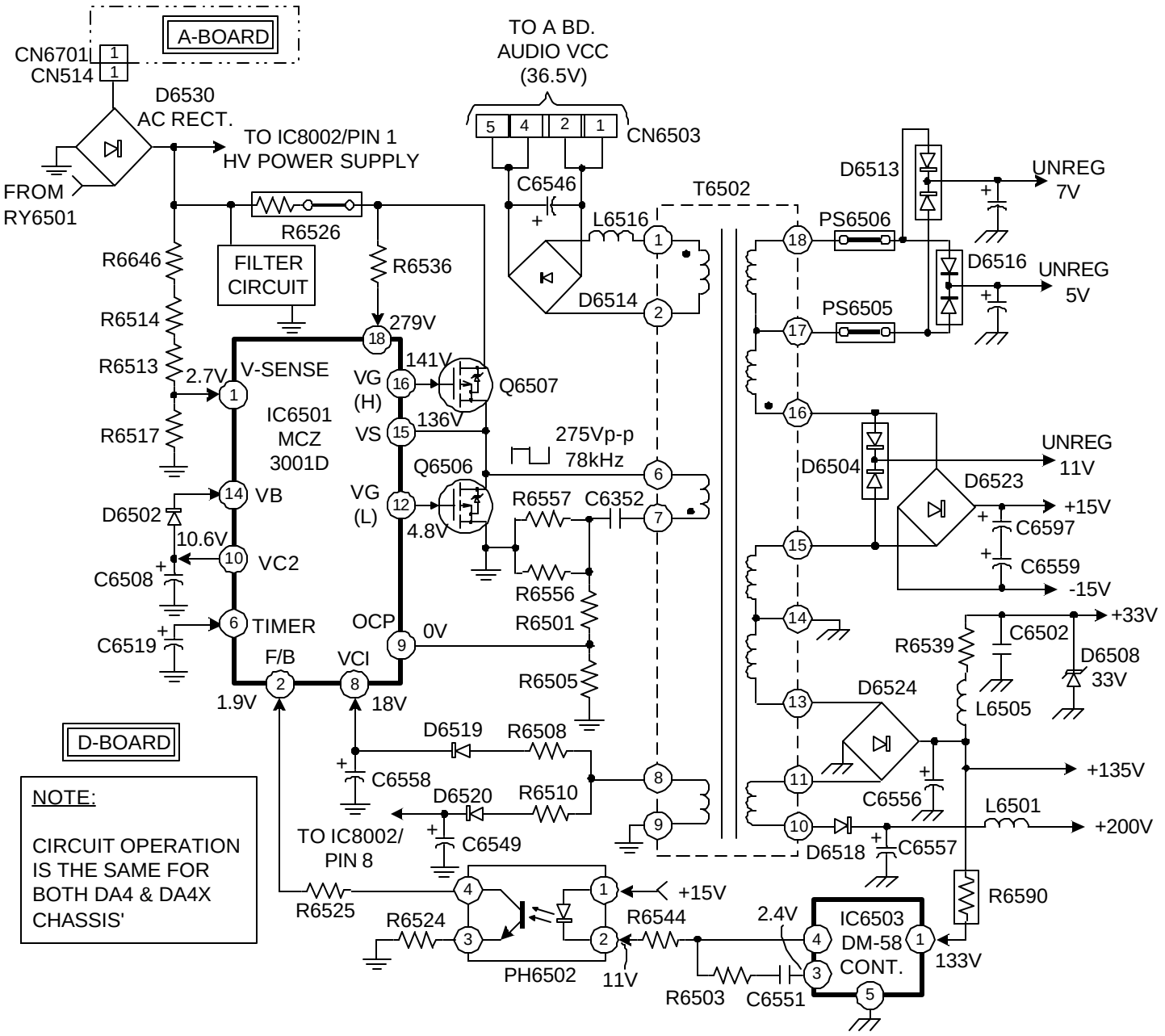


FIGURE 3-3- DA-4 MAIN POWER SUPPLY CIRCUIT C31P15-3-3 1506 11/8/02

The Main Switching Power supply is basically IC6501 (Switch Regulator Controller). IC6501 contains all the major circuitry necessary to function as a switching power supply, except for the Power Switching MOSFETS (Q6507 and Q6506).

IC6501 contains:

- Control circuit
- Oscillator/Oscillator control
- Output Driver transistors
- 10V regulator
- Shut-Off Timer
- Over Current Protection

Main Switching Power Supply Operation

Reference Figure 3-3 for the following circuit description:

AC signal is applied to the rectifier block D6530. The AC component is filtered-out by the filter circuit (shown in block form). A DC voltage of 293V is produced at the output of the filter circuit.

IC6501 Startup Sequence

1) **Turn ON voltage:** The 293Vdc from the filter circuit is voltage divided by R6646, R6514, R6513 and R6517 down to 2.7Vdc. This voltage is applied to IC6501/pin 1 (Vsense) and IC6501 turns ON. IC6501/ pin1 (Vsense) is also used for OVP protection (IC6501/pin 1 > 8V will trigger OVP).
2) **Internal circuit Start Voltage:** The 293Vdc also passes through voltage dropping resistors R6526 and R6536, and 279Vdc is applied to IC6501/pin 18. This voltage is used to initially power the internal circuits and begin oscillations. Note that the 293Vdc from R6526 is connected directly to the Drain of Q6507 and serves as the High-side FET power source.

   Internal circuits initially powered by IC6501/pin 18

   - Internal drive transistors for High-side output FET Q6507.
   - Oscillator
   - Control circuit
   - 10V regulator (IC6501/pin 10)

     Note: The 10V output at IC6501/pin 10 passes through D6502 and supplies power to the internal driver transistor for the Low-side output FET Q6506
3) **Output Oscillations:** At this point, initial square-wave oscillations of approximately 125KHz are output at IC6501/ pins 16 and 12. Normal operation frequency is approximately 85KHz.
4) **Regulator Feedback**: The feedback line is connected to the +135V secondary output. Once IC6501 is turned ON and oscillations begin, the secondary winding at T6502/pin 13 and associated circuitry produces +135V. The +135V is applied to IC6503/pin 1 (DM-58 Control).

   IC6503 controls the voltage at the PH6502/pin 2, which controls the current output of the optic-coupler PH6502. The amount of current supplied to IC6501/pin 2 depends on how hard PH6502 is turned ON. In normal operation, a voltage of 1.9Vdc (which is proportional to the amount of current) is present at IC6501/pin 2. The feedback loop is now complete.
5) **IC6501 normal operating power supply (VC1)**: Produced simultaneously with the oscillator feedback is the operating power source VC1.

   IC6501/pin 8 (VC1) is produced using a winding on T6502/pin 8. The AC is rectified and filtered, and a DC voltage of 18V is applied to IC6501/pin 8. Once the 24V is stable, IC6501's internal control circuit disconnects (internally) the power source at IC6501/pin 18. All IC6501 internal circuits are now powered from IC6501/pin 8.

Over Current Protection (OCP): ref. Figure 3-3

The current flowing through the switching FETS (Q6507 & Q6506) also passes through T6502/pins 6 and 7, C6532 and resistor bank R6557 and R6556. The voltage drop across resistor bank R6557 and R6556 is directly proportional to the current through the switching FETS. The voltage across R6557 and R6556 is further voltage divided by R6501 and R6505 and applied to IC6501/pin 9. The OCP is activated when the voltage at IC6501/pin 9 exceeds 0.2V. The self-diagnostic indicator will flash four times, pause and then repeat.

Over Voltage Protection (OVP) and Under Voltage Protection (UVP): The voltage at IC6501/pin 8 (VC1) is monitored by circuitry inside IC6501 for **Under-voltage** and **Over-voltage conditions**. The two conditions are as follows:

OVP – greater than 33V

UVP – less than 8V

If either of these two conditions occurs at IC6501/pin 8, the unit will go into protection mode. The self-diagnostic indicator will flash four times, pause and then repeat.

Troubleshooting Tips (ref. Figure 3-3)

NOTE: Follow previously discussed "IC6501 Startup Sequence". The five steps are in order of occurrence.

NOTE: Use HOT GRND when making measurements on primary side of T6502. This includes all measurements on IC6501.

Symptom: Unit goes into protection mode, LED flashes four times.

Check: This indicates either a Vertical deflection or power supply problem.

1) Check power supply secondary outputs.

- If voltages are present and at proper the level, then the problem is in the Vertical deflection drive circuit.
- If the secondary voltages are low or missing, then the problem is in the power supply.

2) The power supply can be safely tested by unloading the +135v line. Unsolder R5013. This will unload the +135V line of the power supply, but still send necessary feedback to IC6501 for proper power supply operation.

3) If the power supply outputs proper secondary voltages after unsoldering R5013, suspect a shorted +135V line

4) If the unit still goes into protection mode after unsoldering R5013, check the following items:

- D6538 (5V Zener) for shorted condition.
- Check IC6505 (B+ OVP) for proper operation.
- IC6501/pin 15 (this is midpoint for output MOSFETS Q6507 and Q6506). A 275Vpp, 85KHz square-wave should be present. If the waveform pulses four times and stops, check the next Item.
- IC6501 Feedback circuit. The amount of current feedback can be determined by monitoring the voltage drop across R6525. The minimum current feedback is 80uA, which is a minimum voltage drop of 37.6mV. In normal operation, this voltage drop is approximately 223mV. If the voltage drop is below 37.6mV, suspect components in the feedback path e.g. PH6502 and IC6503. Reference Figure 3-3 for proper voltages at these components.
- If no waveform is present when the unit is turned ON, then check IC6501/pins 1 and 18 for proper voltages (reference "IC6501 Startup Sequence" above).

  If these voltages check OK, check IC6501/pin 8 for proper voltage of 24V. This is the voltage used to power IC6501 after initial startup.

  If 18V is present at IC6501/pin8, check IC6501/pin 10 for 10.2V. This voltage is developed using the 18Vs and a voltage regulator circuit inside IC6501. If 10.2V is missing, suspect a defective IC6501. Also check voltage at IC6501/pin 14 **(Use battery powered DVM for this measurement and use IC6501/pin 15 (VS) as ground ref.)**. The voltage at IC6501/pin 14 should be 10V. If the voltage measured at IC6501/pin 14 is incorrect, check D618.
- If all the above measurements check OK, suspect a defective IC6501.

DA-4 High Voltage (HV) Power Supply Circuit

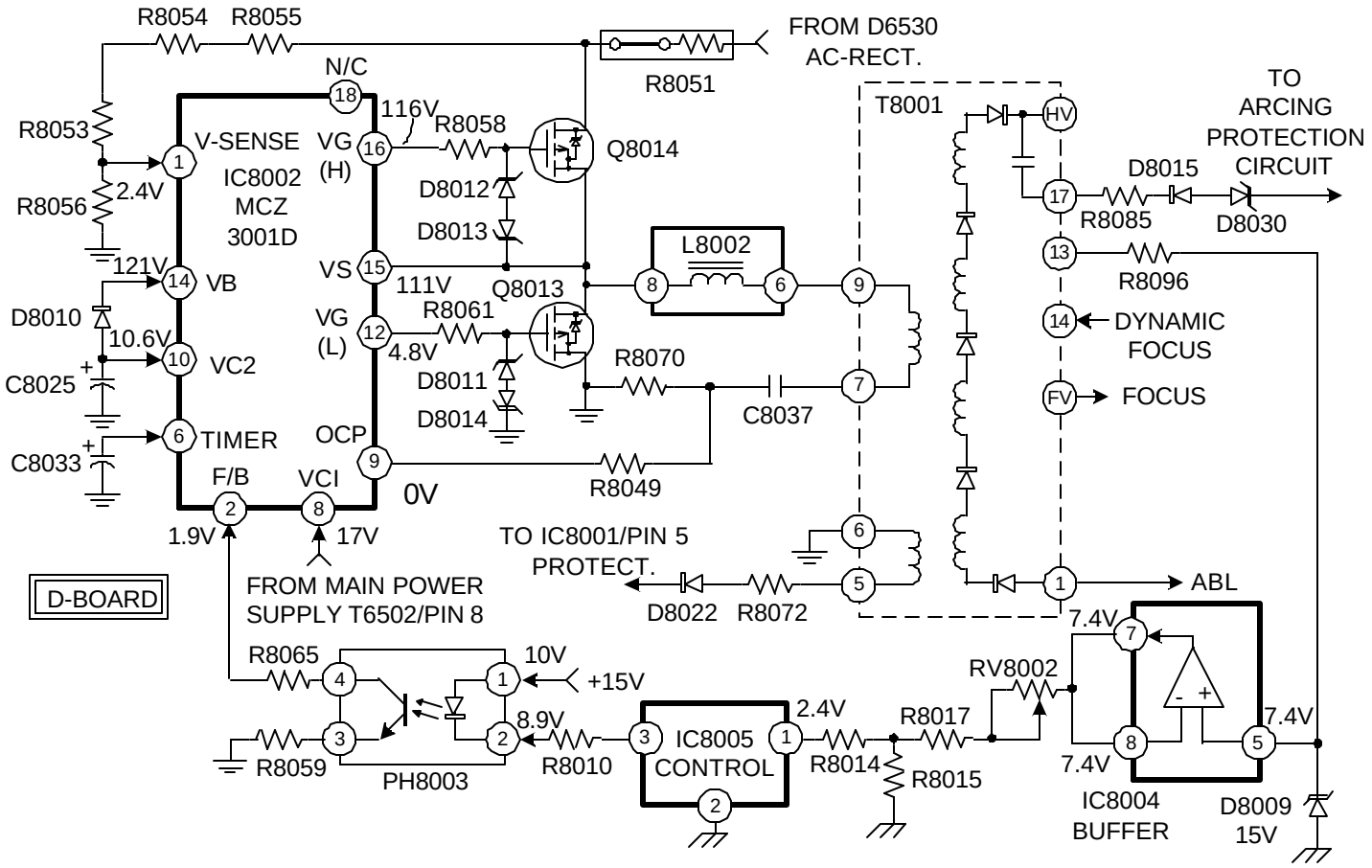


FIGURE 3-4 - DA-4 HV POWER SUPPLY CIRCUIT C31P15-3-4 1507 11/8/02

The HV Switching Power Supply uses the same switching IC as in the Main Power Supply (MCZ3001D). So, the theory of operation of IC8002 will be identical to that of IC6501 (reference IC6501 Startup Sequence text for details) except for the following differences:

IC8002/pin 18 is not used because VC1 is supplied from the T6502/pin 8 in the Main Power Supply circuit. Pin 18 is only needed when the switching IC (MCZ3001D) must supply its own VC1 through the output transformer.

DA-4X Chassis Power Supply

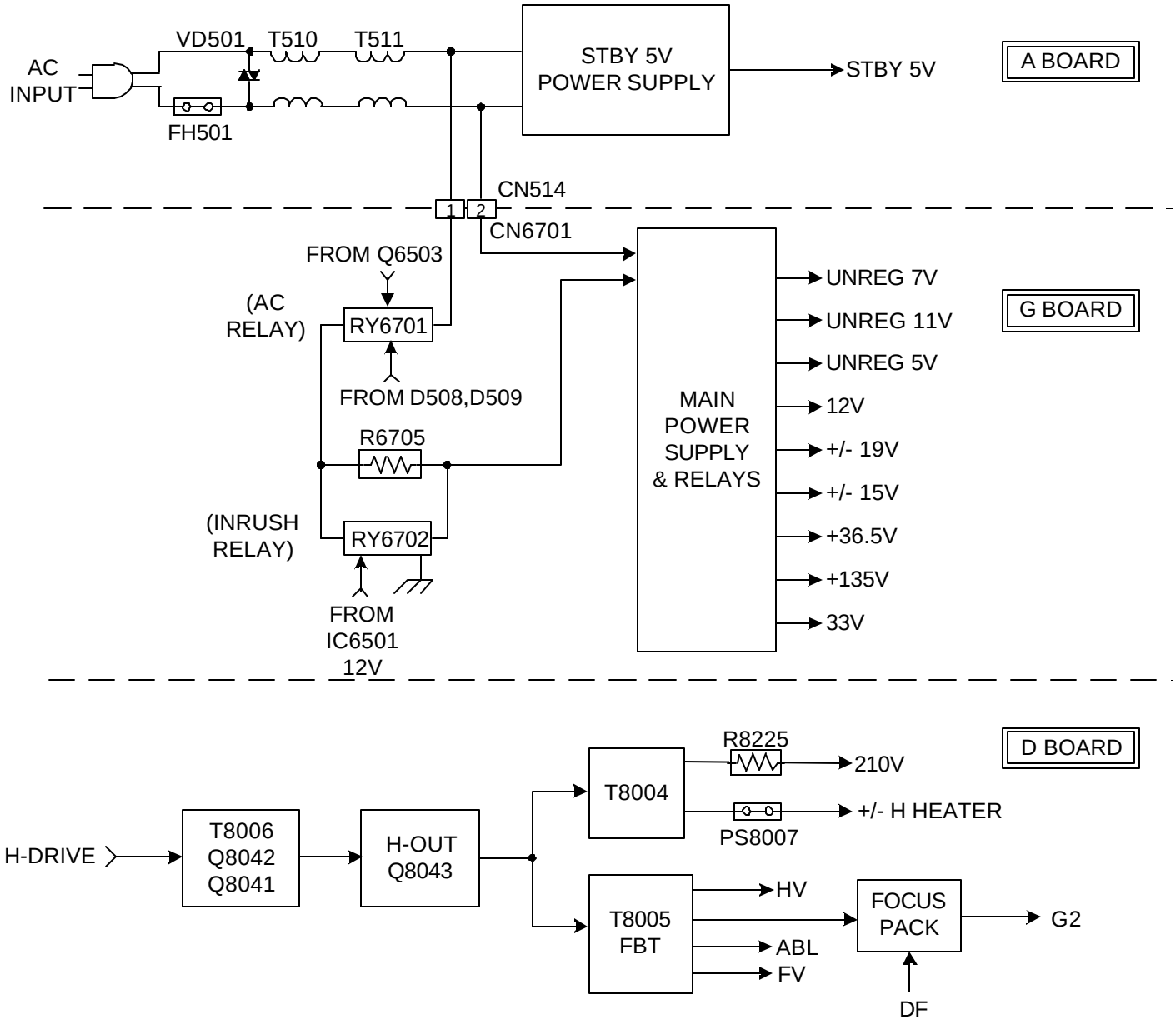


FIGURE 3-5 - DA-4X POWER SUPPLY OVERALL BLOCK C31P15-3-5 10/16/02

The A-board in the DA-4X chassis is identical to the A-board in the DA-4 chassis except for small mute and protections circuits, which will be discussed later. The 120V AC input is applied to the **A-board** and is applied to the **STBY 5V power supply**. Regulator STBY 5V is sent to the M-Board to partially power system control IC2300, and also to the HA/HC board to power the Remote Control Sensor (SIRCS).

The **Main Converter power supply** for the DA-4X chassis is located on the **G-board**. The circuitry and the operation of the Main Converter power supply in the DA-4X are identical to the DA-4 chassis, except for three additional output voltages: +/- 19V, 12V and 33V, and the exclusion of the +200V line.

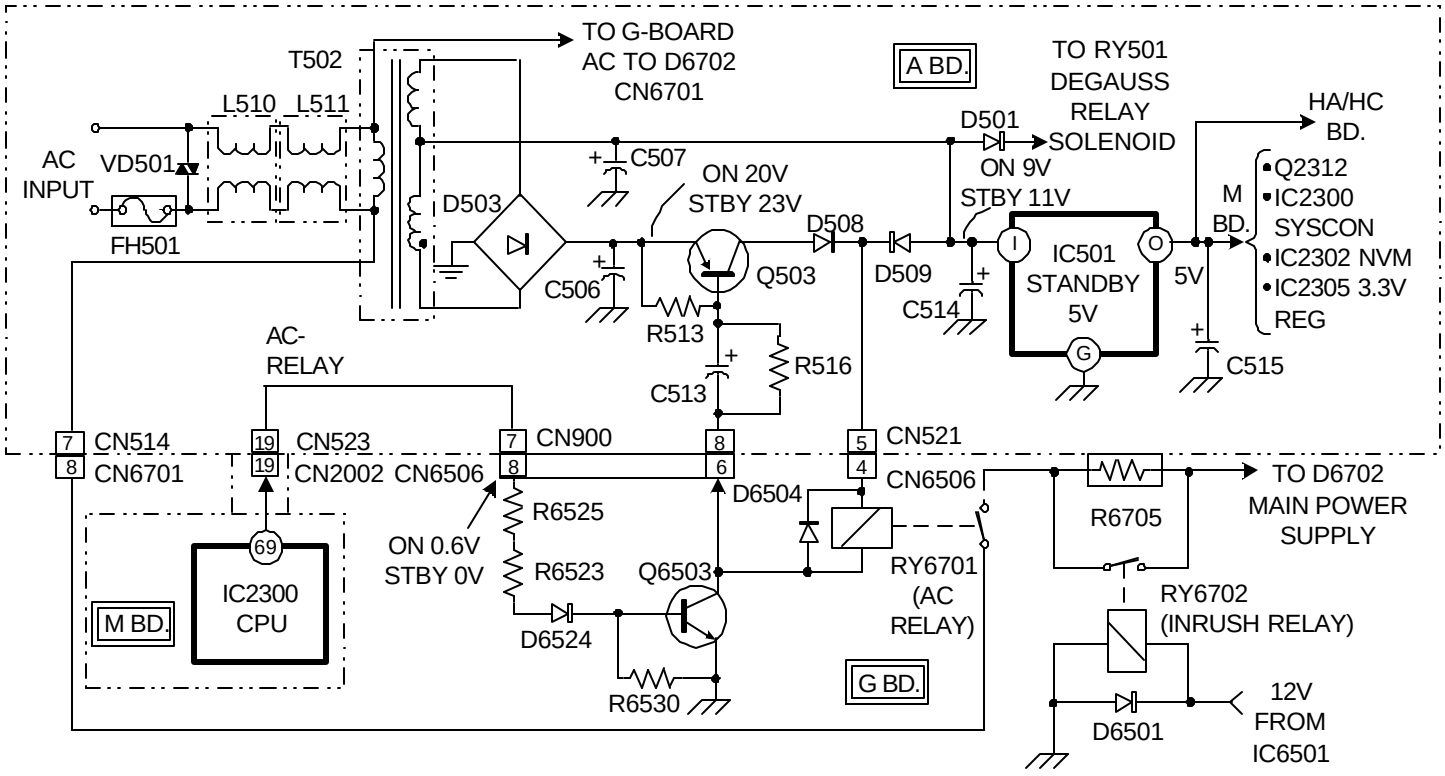
- +/-19V
- +/- 15V
- Unreg-7V

- Unreg-5V
- Unreg-11V
- 12V
- 33V
- 36.5V
- +135

The **+200V, HV, FV, G2, and Heater** are all scan derived on the **D-board** in the DA-4X chassis. The horizontal output Q8043 drives T8004 to produce the +200 and Heater voltages, and also drives T8005 (FBT) to produce HV, FV, G2 and ABL voltages.

- High Voltage (HV)
- Focus Voltage (FV)
- G2
- +200V
- +/-Heater
- ABL

DA-4X STBY 5V Power Supply & Power-On Switching Circuit



NOTE:

CIRCUIT OPERATION IS THE SAME FOR BOTH DA4 & DA4X CHASSIS'

FIGURE 3-6 - DA-4X STANDBY 5V POWER SUPPLY & POWER ON SWITCHING CIRCUIT

C31P15-3-6A 1514 11/7/02

Standby 5V Power Supply

Reference Figure 3-6 during the following circuit description:

The Standby Power Supply (located on the A-board) is operational as long as the set is plugged into an AC outlet. AC power is applied to T502 through fuse FH501, and chokes L510 and L511. T502 couples the AC across to D503 rectifier block and filter capacitor C507 (AC is also coupled to Q503 this is part of the power-on switching circuit which will be discussed next).

The **Standby 5V** power supply is a simple conventional full-wave (only two diodes in D503 are used) rectifier circuit. The resulting DC voltage (13V) is applied to the input pin of IC501 (5V regulator), which then supplies regulated 5V to the following components:

- **IC2300 System Control (M-board)**
- **IC2302 NVM (M-board)**
- **IC2305 3.3V Regulator (M-board)**
- **Q2312 Remote Input Buffer**
- **HA/HC boards (Key Input, LED, and Remote Sensor)**

Power-ON Switching Circuit

Reference Figure 3-6 during the following circuit description:

In the Standby mode, System Control (IC2300) is partially powered (using STBY 5V and 3.3V), and waiting for an ON command from either the Front Panel Controls (IC2300/pins 93 and 94) or the Remote Control (IC2300/pin 7) (circuit not shown).

Once the ON command is received, IC2300/pin 69 (AC_RLY) outputs a high, which is applied to the base of Q6503, turning Q6503 ON. This completes the ground path for the AC Relay (RY6701) and for the base circuit of Q503.

Q503 turns on and supplies the initial kick voltage and current through D508 to RY6701, closing the relay switch and supplying AC power to the Main Power Supply through Inrush resistor R6705 and D6702. Once C513 in the base circuit charges completely Q503 turns off; D508 reverse biases and D509 forward biases, supplying a hold voltage (9V) to keep the relay switch closed in the ON mode.

At this point the Main Power supply is turning ON (operation will be discussed next). The initial AC power to the Main Power Supply is through **Inrush resistor R6705**, which limits the high surge current that occurs momentarily at turn ON. Once the secondary voltage UNREG 11V is developed on T6703 in the Main Power Supply, it is fed back to the **Inrush Relay (RY6702)**. RY6702 turns on and bypasses R6705 in the ON mode. R6705 is only in the circuit during initial power-up of the set.

Troubleshooting Tip:

Obviously, if a failure occurs in the 5V Standby Power Supply the unit will not even attempt to turn ON. If this condition occurs, check the following components:

1) FH501
2) 13V at IC501 Input Pin (I). If missing, suspect T502, D503, and/or C507
3) 5V at IC501 Output Pin (O). If missing, suspect a defective IC501.
4) NOTE: Q503 is used as a current source for the AC relay (RY6701). If the collector/emitter junction of Q503 becomes an Open circuit, the set will still turn ON (using voltage through D509) and function properly with sufficient AC power input. If the AC power input is weak (Low Voltage ~90VAC), the unit will have difficulty turning ON without Q503 functioning properly.

DA-4X Main Switching Power Supply Circuit

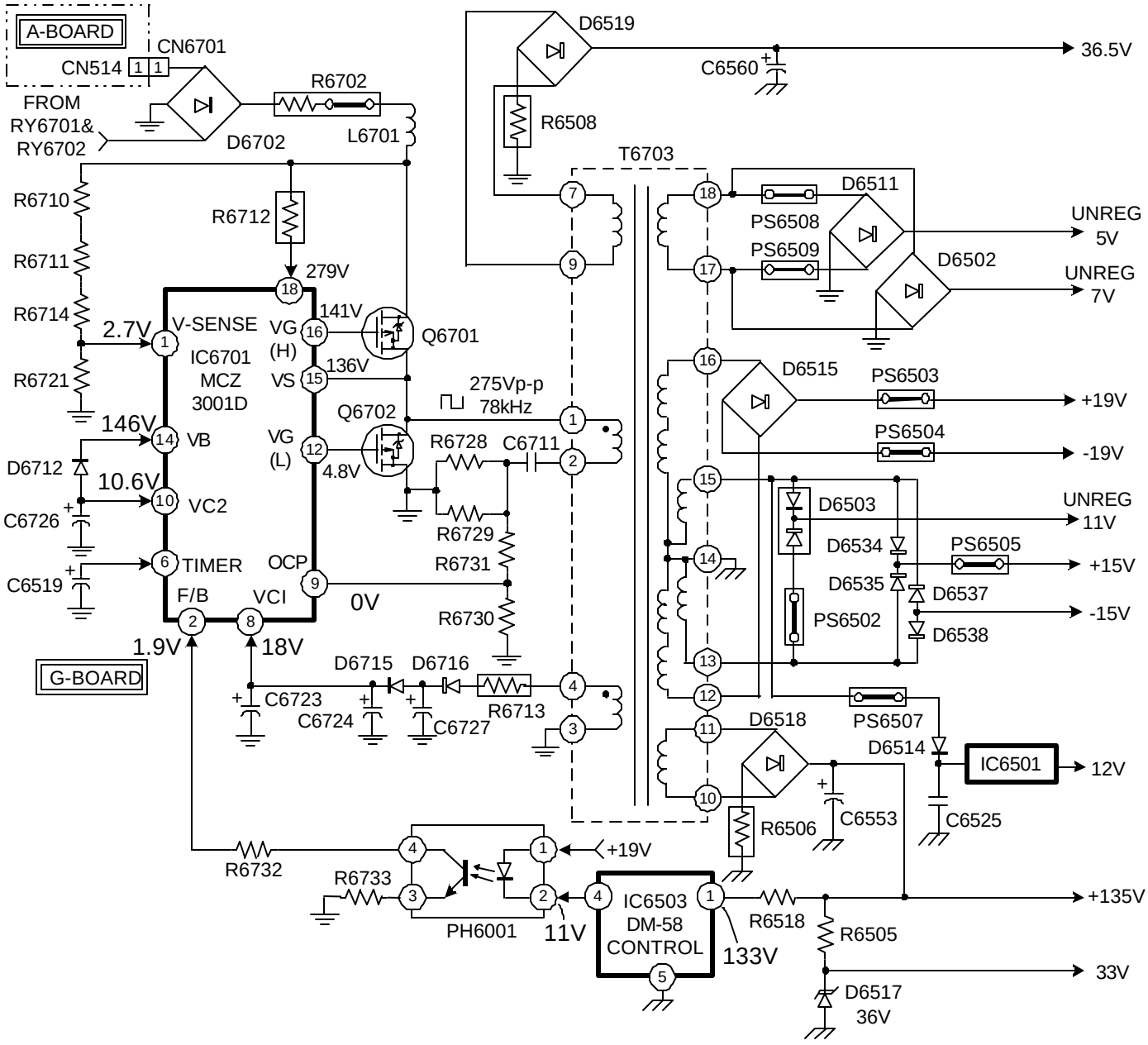


FIGURE 3-7 - DA-4X MAIN POWER SUPPLY CIRCUIT CP31P15-3-7 1513 11/6/02

The Main Switching Power supply is basically IC6701 (Switch Regulator Controller). IC6701 contains all the needed circuitry necessary to function as a switching power supply, except for the Power Switching MOSFETS (Q6701 and Q6702).

IC6701 contains:

- Control circuit
- Oscillator/Oscillator control
- Output Driver transistors
- 10V regulator
- Shut-Off Timer
- Over Current Protection

Main Switching Power Supply Operation

Reference Figure 3-7 for the following circuit description:

AC signal is applied to the rectifier block D6702. The AC component is filtered-out by the filter circuit (shown in block form). A DC voltage of 293V is produced at the output of the filter circuit.

IC6701 Startup Sequence

1) Turn ON voltage: The 279Vdc from the filter circuit is voltage divided by R6710, R6711, R6714 and R6721 down to 2.7Vdc. This voltage is applied to IC6701/pin 1 (Vsense) and IC6701 turns ON. IC6701/pin1 (Vsense) is also used for OVP protection (IC6701/pin 1 > 8V will trigger OVP).

2) Internal circuit Start Voltage: The 279Vdc also passes through voltage dropping resistors R6702 and R6712, and 291Vdc is applied to IC6701/pin 18. This voltage is used to initially power the internal circuits and begin oscillations. Note that the 279Vdc from R6702 is connected directly to the Drain of Q6701 and serves as the High-side FET power source.

Internal circuits initially power by IC6501/pin 18

- Internal drive transistors for High-side output FET Q6701
- Oscillator
- Control circuit
- 10V regulator (IC6701/pin 10)

  Note: The 10V output at IC6701/pin 10 passes through D6712 and supplies power to the internal driver transistor for the Low-side output FET Q6702

3) Output Oscillations: At this point, initial square-wave oscillations of approximately 125KHz are output at IC6701/ pins 16 and 12. Normal operation frequency is approximately 85KHz.

4) Regulator Feedback: The feedback line is connected to the +135V secondary output. Once IC6701 is turned ON and oscillations begin, the secondary winding at T6703/pin 11 and associated circuitry produces +135. The +135V is applied to IC6503/pin 1 (DM-58 Control).

IC6503 controls the voltage at the PH6001/pin 2, which controls the current output of the optic-coupler PH6001. The amount of current supplied to IC6701/pin 2 depends on how hard PH6001 is turned ON. In normal operation, a voltage of 1.9Vdc (which is proportional to the amount of current) is present at IC6701/pin 2. The feedback loop is now complete.

5) IC6701 normal operating power supply (VC1): Produced simultaneously with the oscillator feedback is the operating power source VC1.

IC6701/pin 8 (VC1) is produced using a winding on T6703/pin 4. The AC is rectified, filtered and a DC voltage of 18V is applied to IC6701/pin 8. Once the 24V is stable, IC6701's internal control circuit disconnects (internally) the power source at IC6701/pin 18. All IC6701 internal circuits are now powered from IC6701/pin 8.

Over Current Protection (OCP): ref. Figure 3-7

The current flowing through the switching FETS (Q6701 and Q6702) also passes through T6703/pins 1 and 2, C6711 and resistor bank R6728 and R6729. The voltage drop across resistor bank R6728 and R6729 is directly proportional to the current through the switching FETS. The voltage drop across R6557 and R6556 is further voltage divided by R6731 and R6730 and applied to IC6701/pin 9. The OCP is activated when the voltage at IC6701/pin 9 exceeds 0.2V. The self-diagnostic indicator will flash four times, pause and then repeat.

Over Voltage Protection (OVP) and Under Voltage Protection (UVP): The voltage at IC6701/pin 8 (VC1) is monitored by circuitry inside IC6701 for **Under-voltage** and **Over-voltage conditions**. The two conditions are as follows:

OVP – greater then 33V

UVP – less then 8V

If either of these two conditions occurs at IC6501/pin 8, the unit will go into protection mode. The self-diagnostic indicator will flash four time times, pause and then repeat.

Troubleshooting Tips (ref. Figure 3-3)

NOTE: Follow previously discussed "IC6701 Startup Sequence". The five steps are in order of occurrence.

NOTE: Use HOT GRND when making measurements on primary side of T6703. This includes all measurements on IC6701.

Symptom: Unit goes into protection mode, LED flashes four times.

Check: This indicates either a Vertical deflection or Power Supply problem.

1) Check power supply secondary outputs.
2) If voltages are present and at the proper level, then the problem is in the Vertical deflection drive circuit.
3) If the secondary voltages are low or missing, then the problem is in the power supply.
4) The power supply can be safely tested by unloading the +135v line. Unsolder l6514. This will unload the +135V line of the power supply, but still send necessary feedback to IC6701 for proper power supply operation.
5) If the power supply outputs proper secondary voltages after unsoldering l6514, suspect a shorted +135V line. Check the Horizontal Output transistor (Q505 or 506) for shorted conditions.
6) If the unit still goes into protection mode after unsoldering lC6514, check the following items:
    - IC6701/pin 15 (this is midpoint for output MOSFETS Q600 Q6701 and Q6702). A 275Vpp, 78KHz square-wave should be present. If the waveform pulses four times and stops, check the next Item.
    - IC6701 Feedback circuit. The amount of current feedback can be determined by monitoring the voltage drop across R6732. The minimum current feedback is 80uA, which is a minimum voltage drop of 37.6mV. In normal operation, this voltage drop is approximately 223mV. If the voltage drop is below 37.6mV, suspect components in the feedback path, e.g. PH602 and IC604. Reference Figure 3-7 for proper voltages at these components.
    - If no waveform is present when unit is turned ON, then check IC6701/pins 1 and 18 for proper voltages (reference "IC600 Startup Sequence" above).

      If these voltages check OK, check IC600/pin 8 for proper voltage of 18V. This is the voltage used to power IC6701 after initial startup.

      If 18V is present at IC6701/pin8, check IC6701/pin 10 for 10.2V. This voltage is developed using the 18Vs and a voltage regulator circuit inside IC6701. If 10.2V is missing, suspect a defective IC6701. Also check voltage at IC600/pin 14 **(Use battery powered DVM for this measurement, and use IC6701/pin 15 (VS) as ground ref.)**. The voltage at IC6701/pin 14 should be 10V. If the voltage measured at IC6701/pin 14 is incorrect, check D6712.
    - If all the above measurements check OK, suspect a defective IC600.

DA-4 & DA-4X Regulators

DA-4 & DA-4X Regulator Interconnect Diagram

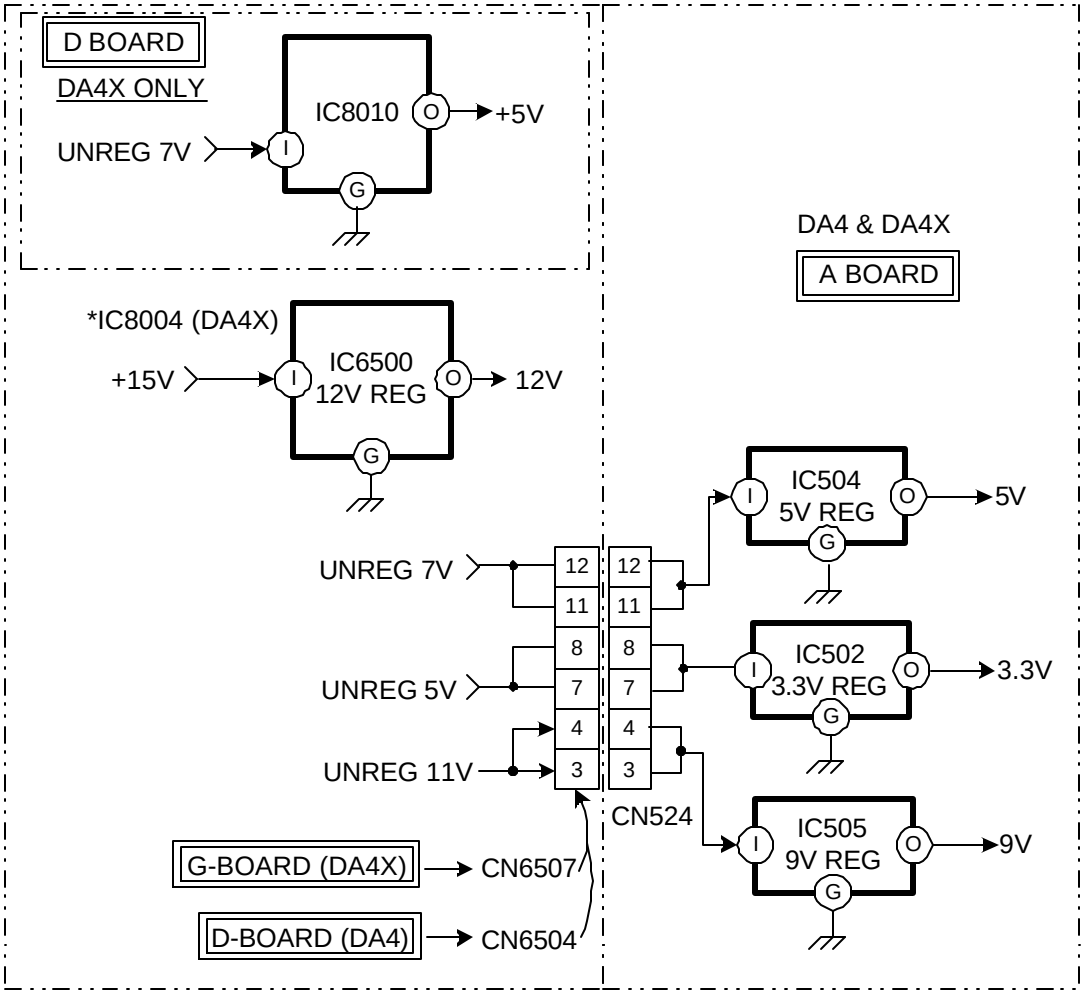


FIGURE 3-8 - DA-4 & DA-4X REGULATOR INTERCONNECT DIAGRAM

C31P15-3-8 10/9/02

The interconnect diagram shown in Figure 3-8 illustrates how the unregulated voltages produced on the D-board (DA-4) and G-board (DA-4X) are used to develop other regulated voltages.

The unreg. 7V is used to develop reg. 5V through IC504; unreg. 5V is used to develop 3.3V through IC502; unreg. 11V is used to develop reg. 9V through IC505. Also, note that in the DA-4X chassis, the unreg. 7V is used to develop a separate reg. 5V on the D-board. In both the DA-4 and DA-4X chassis the reg. +15V is used to develop regulated 12V.

Chapter 4 - DA-4 & DA-4X Protection Circuits

DA-4 Protection Circuits

Overall Block Diagram

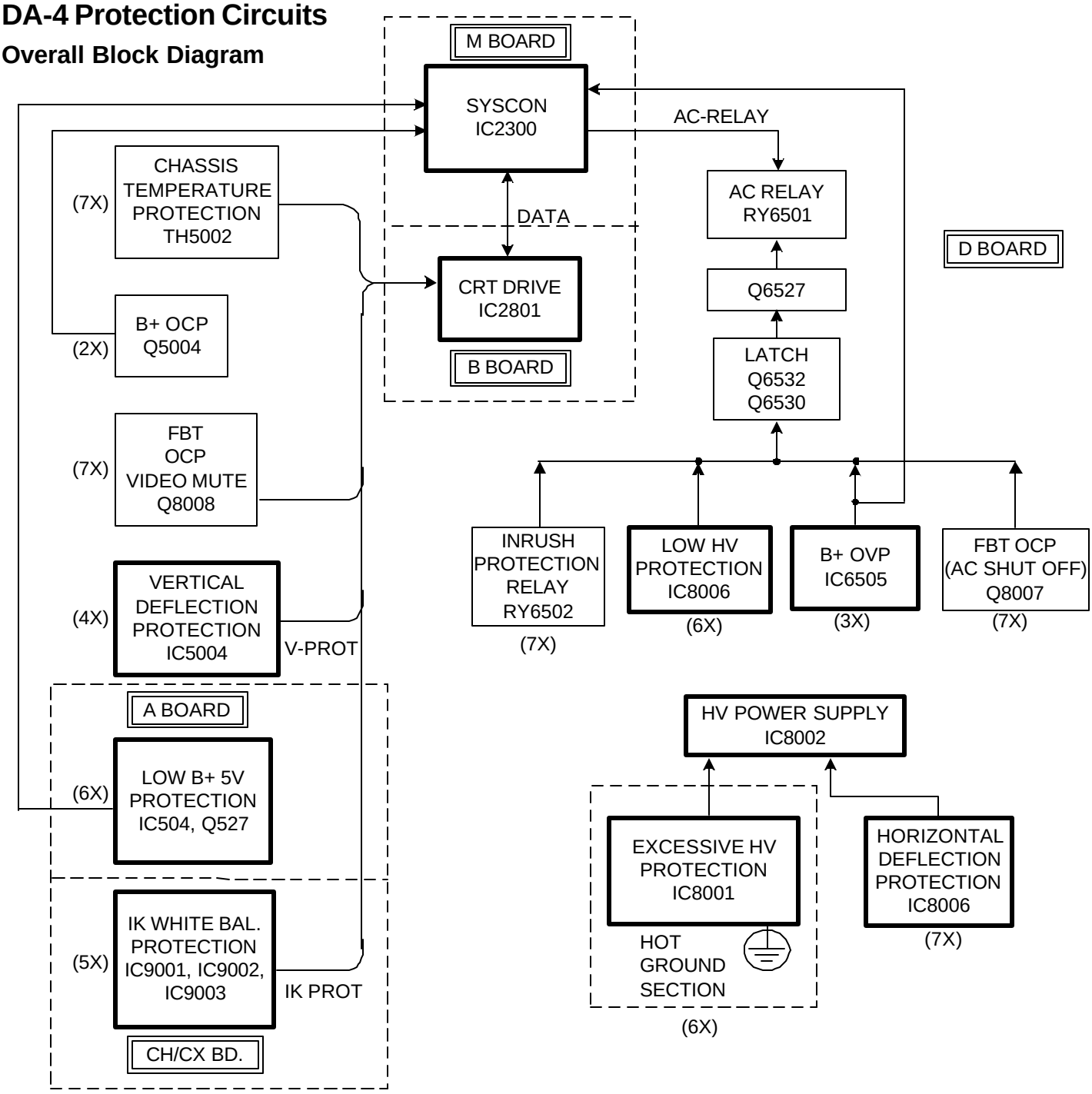


FIGURE 4-1 - DA-4 PROTECTION CIRCUITS OVERALL BLOCK

C31P15-4-1 10/30/02

Figure 4-1 is a basic block diagram illustrating the interconnection of the protection circuit, System control and the AC relay. Also shown on the diagram is the Standby/Timer LED flash sequence for when the particular protection circuit is triggered (e.g. 4X will occur with a vertical deflection failure). Each protection circuit will be discussed in greater detail in coming diagrams. The purpose for each protection circuit is indicated by the name of the particular block.

The important thing to note on this diagram is the protection circuits that have a direct connection to the CPU and those that do not. The protection circuits that have a direct connection will produce a more reliable flash sequence e.g. 2X, 3X, 4X, and 6X. The circuits that do not have a direct connection may produce a 7X or 6X flash sequence.

TH5002 is used to monitor the temperature of Q5031 (S-Correction Output). If this transistor should become a short circuit, the current will increase which causes an increase in temperature. TH5002 detects the rise in temperature, the Video is muted and AC input is disconnected through IC2801 (CRT Drive) and data communications with IC2300 (Syscon).

Q5004 monitors the current draw on the +135V line. If the current should increase, video is muted via IC2801 and IC2300. Also note that there is a direct connection from the B+ OCP circuit and IC2300 Syscon for quick disconnection of AC input.

Q8008 monitors the current in the secondary of the FBT using the ABL voltage. If excessive current flows in the FBT, Q8008 is used to mute the video. Q8008 works simultaneously with Q8007, which turns off the AC relay.

IC5004 is the vertical deflection output drive IC. A feedback pulse is produced at IC5004/pin 3. If a vertical failure occurs, the feedback pulse is not produced and the video is muted (AC input and Audio remain ON).

Q2314 monitors the 5V dc level. If the dc level falls below 4.5V, Q2314 detects this error and the AC input is disconnected.

IC9001, 9002, and 9003 on the CH/CX board are the cathode drive ICs. Each IC produces a separate IK pulse directly proportional to the current in each cathode. The current in each cathode indicates the physical condition of the cathode. Depending on the cathode condition the set will either increase RGB drive to the cathode or go into IK Protection mode.

RY6502 is used to bypass the Inrush Current resistor from the AC input circuit after initial set turn-on. If the relay failures to activate, AC input is disconnected.

IC8006 monitors the HV output. If the HV is low, IC8006 detects this condition and the AC input is disconnected.

IC6505 monitors the +135 voltage level. If the voltage increases, IC6505 will disconnect the AC input.

Q8007 monitors the current in the FBT secondary. If the current increases, Q8007 will disconnect the AC input. Q8007 works simultaneously with Q8008, which mutes the video output.

IC8001 monitors the HV level. **NOTE: this circuit is on the HOT (or primary) side of the transformer, so use HOT Ground for measurements.** If the HV increases, IC8001 will turn off the HV converter IC8002.

IC8006 monitors the horizontal deflection output drive. If the horizontal deflection stops, IC8006 will turn-off the HV converter IC8002.

DA-4 Direct AC-Relay Shut-Off Protection Circuits

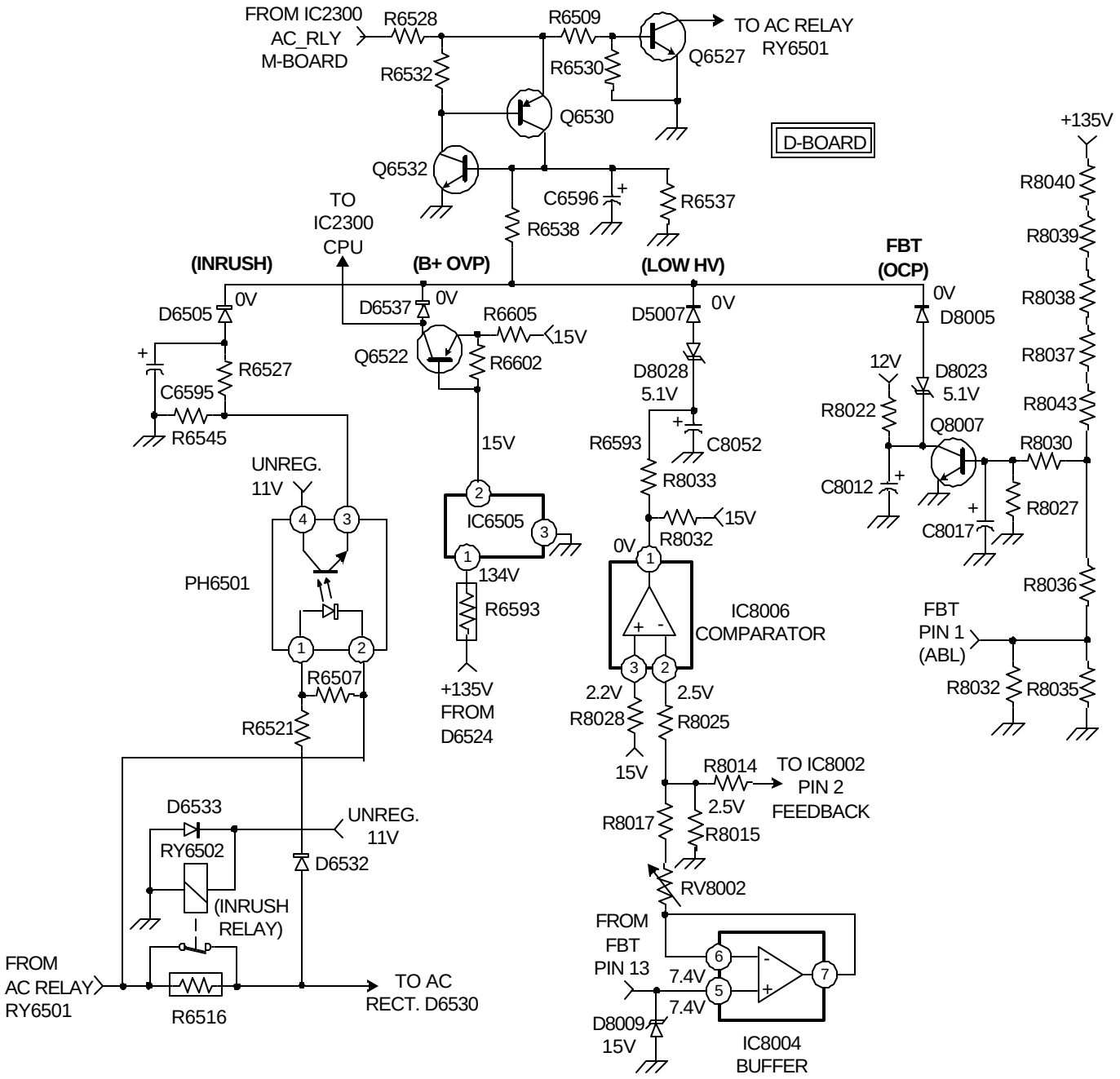


FIGURE 4-2 - DA-4 DIRECT AC-RELAY SHUT-OFF PROTECTION CIRCUITS C31P15-4-2 1517 11/15/02

As shown in Figure 4-2, four protection circuits, when triggered, will turn off the AC relay directly. The circuits are as follows:

1) Inrush protection relay
2) B+ OCP
3) Low HV protection
4) FBT OCP

Inrush Current Relay Protection Circuit

(Reference Figure 4-2)

The current rating of the AC relay (RY65010) is 117mA at 153VAC. To keep the current below 117mA resistor **R6515 (Inrush Current Resistor)** is in series with the AC input during the initial power-up of the TV. After the initial power-up current surge, R6516 is bypassed when **RY6502 (Inrush Relay)** is energized and the switch is closed.

The operation of RY6502 is monitored using **R6516 and PH6501**. If RY6502 does not function, a voltage drop will develop across R6515, which in turn develops a voltage across R6507. The voltage across R6507 turns on the LED and 11V is output on PH6501/pin 3. **D6505** is now forward biased and a High is applied to the base of Q6532, turning it ON, which then applies a Low to the base Q6530, turning it ON. **Q6532 and Q6530 is a latching circuit.**

Once the latch is activated, the voltage at the base of Q6527 is reduced and it turns OFF, removing the ground path for the AC Relay and it turns OFF. The TV shuts down and the Stby/Timer LED flashes a **7X sequence**.

B+ OVP

(Reference figure 4-2)

The voltage level of the +135V line is monitored using **IC6505**. If the +135V increases at IC6505/pin 2, the voltage at IC6505/pin 2 will decrease. Once IC6505/pin 2 decreases by 0.6V, Q6522 will turn ON. **D6537** is now forward biased and a High is applied to the base of Q6532, turning it ON, which then applies a Low to the base Q6530, turning it ON (activating the latch).

Once the latch is activated, the voltage at the base of Q6527 is reduced and it turns OFF, removing the ground path for the AC Relay and it turns OFF. The TV shuts down and the Stby/Timer LED flashes a **3X sequence**.

Low HV Protection Circuit

(Reference Figure 4-2)

The HV level is monitored through the HV Regulator circuit. IC8004 and resistor network RV8002, R8017, R8014 and R8015 are part of the HV regulator circuit. A sample of the HV is output at FBT/pin 13 and is applied to IC8004/pin 5 (Buffer). Approximately 7.4V is produced at IC8004/pin 7, which is then applied to the resistor network. Approximately 2.5V is developed at the junction of R8014, R8015 and R8017.

R8014 is the feedback path for IC8002 (HV Power Supply Converter IC) to keep the HV regulated.

R8025 is the path for the Low HV detection circuit. When the 2.5V at IC8006/pin2 decreases below the reference voltage 2.2V at IC8006/pin3, a High will be output at IC8006/pin 1 (approximately 14V) through pull-up resistor R8032. Zener diode D8028 (5.1V) will break down. **D5007** is now forward biased and a High is applied to the base of Q6532, turning it ON, which then applies a Low to the base Q6530, turning it ON (activating the latch).

Once the latch is activated, the voltage at the base of Q6527 is reduced and it turns OFF, removing the ground path for the AC Relay and it turns OFF. The TV shuts down and the Stby/Timer LED flashes a **6X sequence.**

FBT Over Current Protection (IK-Prot. 2)

(Reference Figure 4-2)

The secondary current in FBT is monitored by **Q8007** at FBT/pin 1 (ABL). The +135V is used as the reference voltage through the resistor voltage divider consisting of R8040, R8039, R8038, R8037 and R8043. The combined voltage drop across R8036 and R8035 is used to turn off Q8007 and trigger the protection circuit. In normal operation, 0.6V is applied to the base of Q8007, turning it ON and a Low is present at the collector. A High at the collector is needed to activate the protection mode.

As the current in the FBT secondary increases, the ABL line will increase current through the voltage divider network at the top of R8035 and less current will flow through R8035. The voltage drop across R8035 will decrease, causing the combined voltage drop across R8036 and R8035 to decrease. At the same time, the 0.6V at the base of Q8007 is decreasing, which turns OFF Q8007 and a High will be developed at the collector through pull-up resistor R8022. Zener diode D8023 (5.1V) will break down. **D8005** is now forward biased and a

High is applied to the base of Q6532, turning it ON, which then applies a Low to the base Q6530, turning it ON (activating the latch).

Once the latch is activated, the voltage at the base of Q6527 is reduced and it turns OFF, removing the ground path for the AC Relay and it turns OFF. The TV shuts down and the Stby/Timer LED flashes a **7X sequence.**

DA-4 Excessive HV and horizontal Deflection Protection Circuits

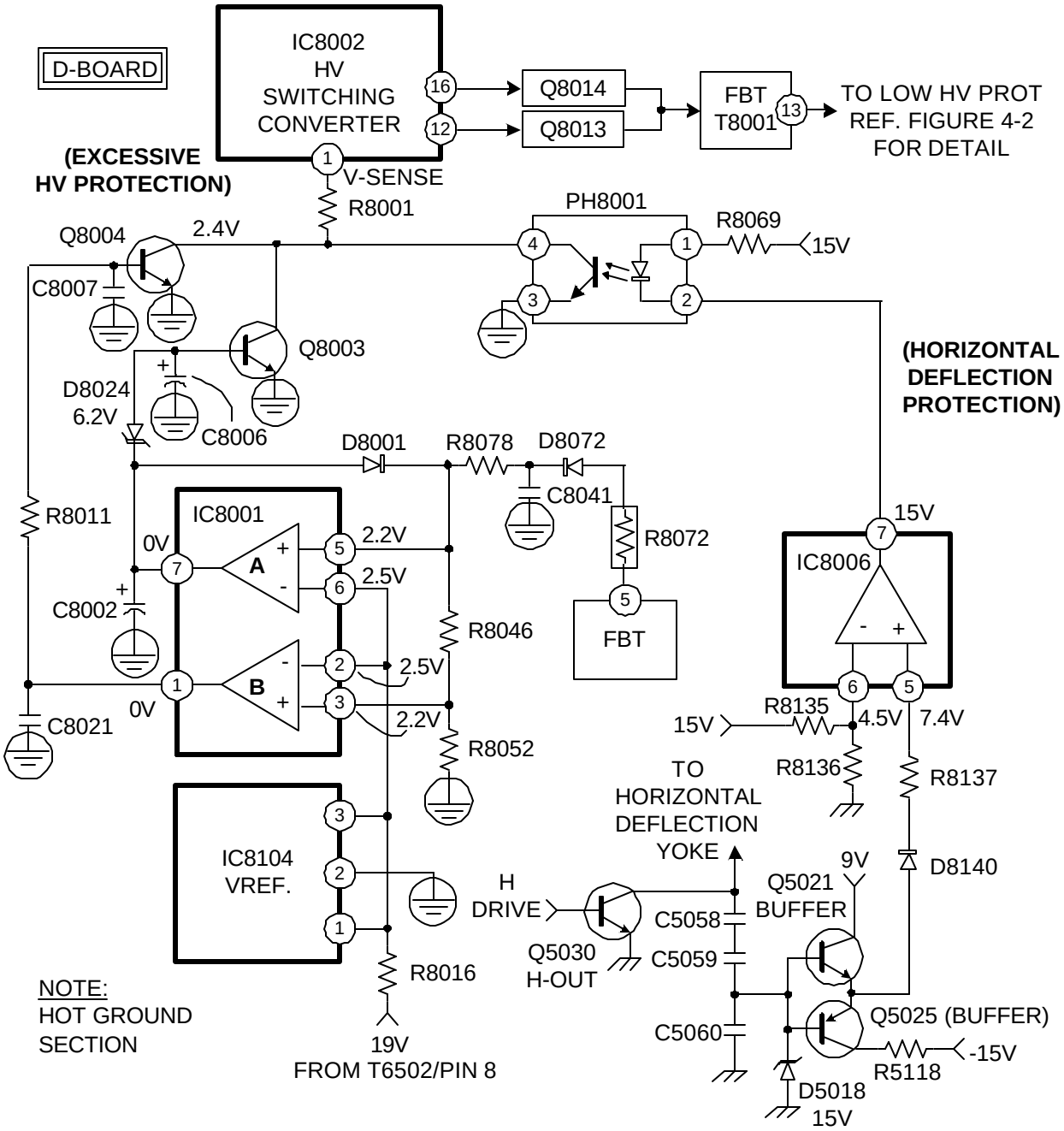


FIGURE 4-3 - DA-4 EXCESSIVE HV AND HORIZONTAL DEFLECTION PROTECTION CIRCUITS C31P15-4-3 1518 11/12/02

Excessive HV Circuit

(Reference Figure 4-3)

The HV is monitored at FBT/pin 5 using two comparator circuits (A & B) located in **IC8001**. Comparator A will be triggered when there is a sustained excessive HV (or **gradual HV increase**), and comparator B will trigger on a momentary (or **fast increase**) HV surge. Another way to look at these comparators circuits is that they are backup circuits for each other (redundant circuits) to ensure shutdown under any excessive HV condition.

Both comparators receive a sample of the HV from FBT/pin 5, which is input to IC8001/pin 5 and IC8001/pin3. A reference voltage (Vref) of 2.2V is developed at IC8014/pin 3 and applied to IC8001/pins 2 and 6. Once the voltage at either IC8001/pin 5 or 3 increases above the reference voltage due to an excessive HV conditions, a High will be output at either IC8001/pin 7 or 1. The High output will turn ON either Q8004 or Q8003, which will then apply a Low to IC8002/pin 1 (V-sense) turning the HV power supply converter IC OFF. Drive to the FBT will stop and HV will not be developed.

The TV shuts down and the Stby/Timer LED flashes a **6X sequence.**

Horizontal Deflection Protection

(Reference Figure 4-3)

A sample of the Horizontal drive pulse is taken off the top of C5060. The pulse at this point is amplitude limited using D5018 to 15V. The sample pulse is first buffer by Q5021 and then applied to comparator IC8006/pin 5 through D8140. Approximately 7.4V is developed at IC8006/pin 5, making it more positive then the reference voltage on IC8006/pin 6 (4.5V). This condition causes a High (15V) to be produced at the output of the comparator IC8006/pin7. The 15V from IC8006/pin 7 is applied to the cathode side of the LED PH8001/pin 2, and 15V is also applied to the anode side of the LED PH8001/pin 1. So, the LED is OFF and the collector/emitter junction at PH8001/pins 4 and 3 is open. 2.4V is present at PH8001/pin 4.

If the horizontal drive to the deflection yoke (possible defective Q5030) were to cease, there would be no sample pulse applied to IC8006/pin 5, and IC8006/pin 5 will go to 0V. This condition will cause IC8006/pin 7 to go Low. This Low is applied to the cathode of the LED PH8001/pin 2, the LED turns ON and the collector/emitter junction PH8001/pins 3 and 4 conduct applying ground to IC8002/pin 1 (V-Sense). This turns the HV power supply converter IC8002 OFF and no drive to the FBT (HV output stops). With no drive to T8001, there will be no output on T8001/pin 13. T8001/pin 13 is connected to IC8004/pin 7 and outputs a low to IC8006/pin 2. This will cause a high to be output at IC8006/pin 1. This high will cause D8028 to break-over and a high will be applied to the latch circuit of Q6532 & Q6530, and the AC relay will be shut-off.

The TV shuts down and the Stby/Timer LED flashes a **7X sequence.**

DA-4 Temperature (Q5031), B+OCP, Vertical Deflection Protection Circuits

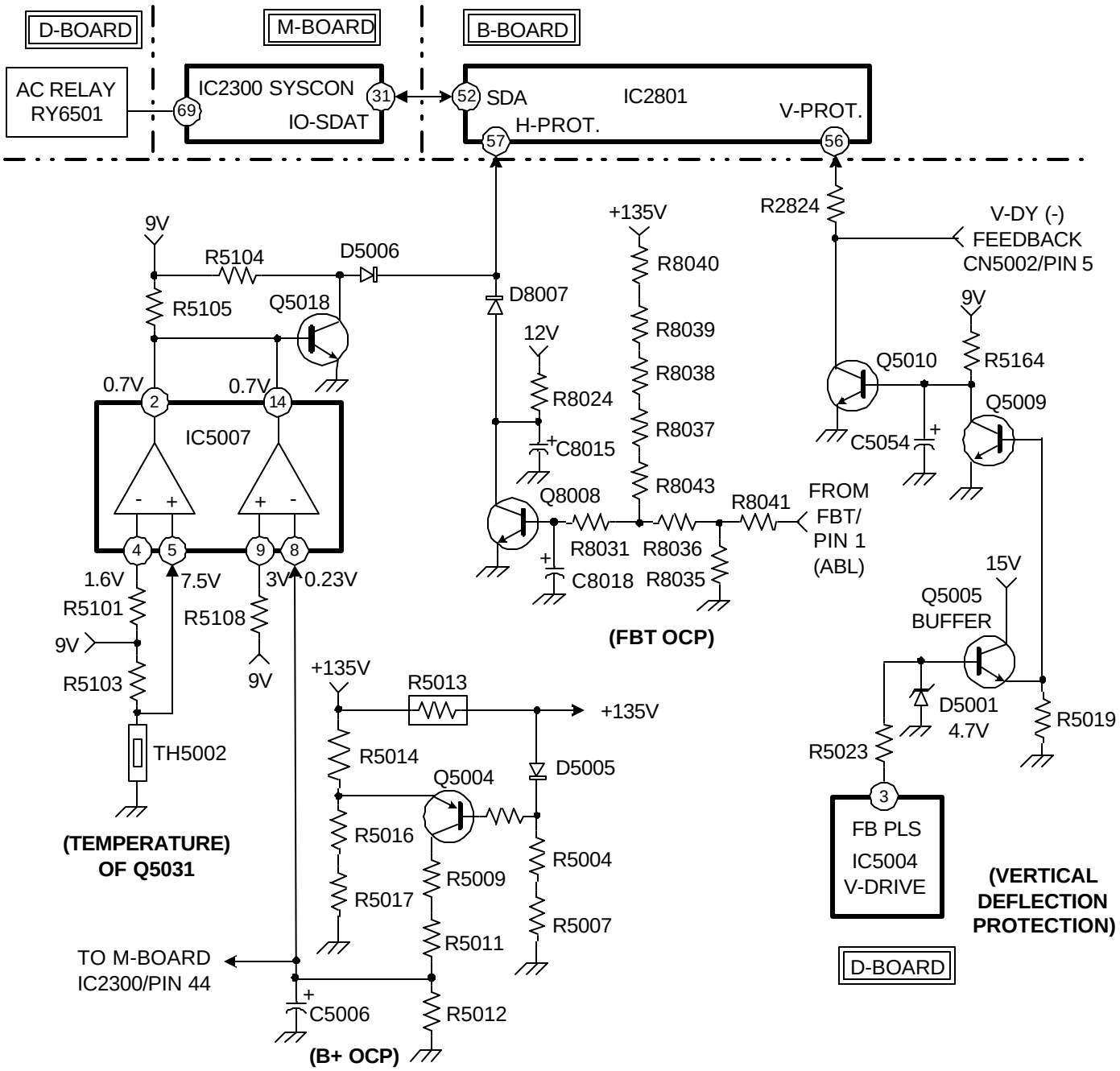


FIGURE 4-4 - DA-4 TEMPERATURE(Q5031), B+OCP, VERTICAL DEFLECTION, PROTECTION CIRCUITS C31P15-4-4 1519 11/12/02

Q5031 Temperature Protection Circuit

(Reference Figure 4-4)

The temperature of the S-Correction transistor Q5031 is monitored using TH5002. If the temperature of Q5031 should increase due to a defect, the resistance of TH5002 will decrease and the voltage at IC5007/pin 5 will decrease. Once the voltage level at IC5007/pin 5 decrease below the reference voltage level at IC5007/pin 4 (1.6V), the comparator output IC5007/pin 2 will go Low and turn Q5018 OFF.

A High through pull-up resistor R5104 is now applied to IC2801/pin 57 (H-Prot) through **forward biased D5006**. IC2801 will mute the video and communicate via IC2801/pin 52 with IC2300/pin 31 to shut off the AC relay at IC2300/pin 69.

The TV video is muted, the AC relay shuts down and the Stby/Timer LED flashes a **7X sequence.**

B+OCP Protection Circuit

(Reference figure 4-4)

The current in the +135V line is monitored using R5013 and Q5004. R5013 is the current sensing resistor. The current in the +135V line flows directly through R5013. The voltage drop across R5013 in normal operation is very low, approximately 0.2V. So, the +135V is passed with very little loss in normal operation. The voltage on the left side is basically equal to the voltage on the right side of R5013, and because R5013 is connected across the base/emitter junction of Q5004, there is no 0.6V difference across the junction and Q5004 is OFF.

When the current in the +135V line begins to increase due to a defect, the voltage drop across R5013 will also increase. Because of the increased voltage drop across R5013, the voltage on the left side of R5013 will remain constant but the voltage on the right side of R5013 will decrease. The decreased voltage on the right side is applied to the base of Q5004 through D5005. Once the voltage drop across R5013 is large enough to cause a 0.6V difference across Q5004 base/emitter junction, Q5004 turns ON.

Current now flows through the voltage divider consisting of R5009, R5011 and R5012. The voltage drop across R5012 is applied to IC5007/pin 8, causing IC5007/pin 8 to become more positive then the reference voltage at IC5007/pin 9 (3V). The output IC5007/pin 14 will go Low and turn Q5018 OFF.

A High through pull-up resistor R5104 is now applied to IC2801/pin 57 (H-Prot) through **forward biased D5006**. IC2801 will mute the video and communicate via IC2801/pin 52 with IC2300/pin 31 to shut off the AC relay at IC2300/pin 69.

The TV video is muted, the AC relay shuts down and the Stby/Timer LED flashes a **2X sequence.**

FBT Over Current Protection Circuit (IK Prot. 1)

(Reference Figure 4-4)

The secondary current in FBT is monitored by **Q8008** at FBT/pin 1 (ABL). The +135V is used as the reference voltage through the resistor voltage divider consisting of R8040, R8039, R8038, R8037 and R8043. The combined voltage drop across R8036 and R8035 is used to turn off Q8008 and trigger the protection circuit. In normal operation, 0.6V is applied to the base of Q8008, turning it ON and a Low is present at the collector. A High at the collector is needed to activate the protection mode.

As the current in the FBT secondary increases, the ABL line will increase current through the voltage divider network at the top of R8035 and less current will flow through R8035. The voltage drop across R8035 will decrease, causing the combined voltage drop across R8036 and R8035 to decrease. At the same time, the 0.6V at the base of Q8007 is decreasing, which turns OFF Q8007 and a High will be developed at the collector through pull-up resistor R8022. **D8007** is now forward biased through pull-up resistor R8024 and a High is applied to IC2801/pin 57. IC2801 will mute the video and communicate via IC2801/pin 52 with IC2300/pin 31 to shut off the AC relay at IC2300/pin 69.

The TV video is muted, the AC relay shuts down and the Stby/Timer LED flashes a **7X sequence.**

Vertical Deflection Protection Circuit

(Reference Figure 4-4)

The operation of the vertical deflection circuit is monitored using the feedback pulse developed at IC5004/pin 3 (vertical drive IC). The pulse is amplitude limited using D5001 (4.7V Zener diode). The pulse passes through buffer Q5005 and is applied to the base of Q5009, turning it ON, while applying a Low to the base of Q5010, turning it OFF. With Q5010 OFF, the V-DY feedback will be applied to IC2801/pin 56 indicating proper vertical deflection operation.

If the Vertical deflection should cease due to a defect, the feedback pulse at IC5004/pin 3 will not be developed (no pulse through Q5005 buffer), Q5009 will turn OFF and Q5010 will turn ON. The V-DY will go to ground IC2801/pin 56 detects the missing V-DY and places the TV in vertical shut down.

In vertical shut down mode, only the video is muted, the AC power and Audio remain ON and the Stby/ Timer LED flashes a **4X sequence.**

DA-4 Regulated 5V and White Balance Protection Circuit

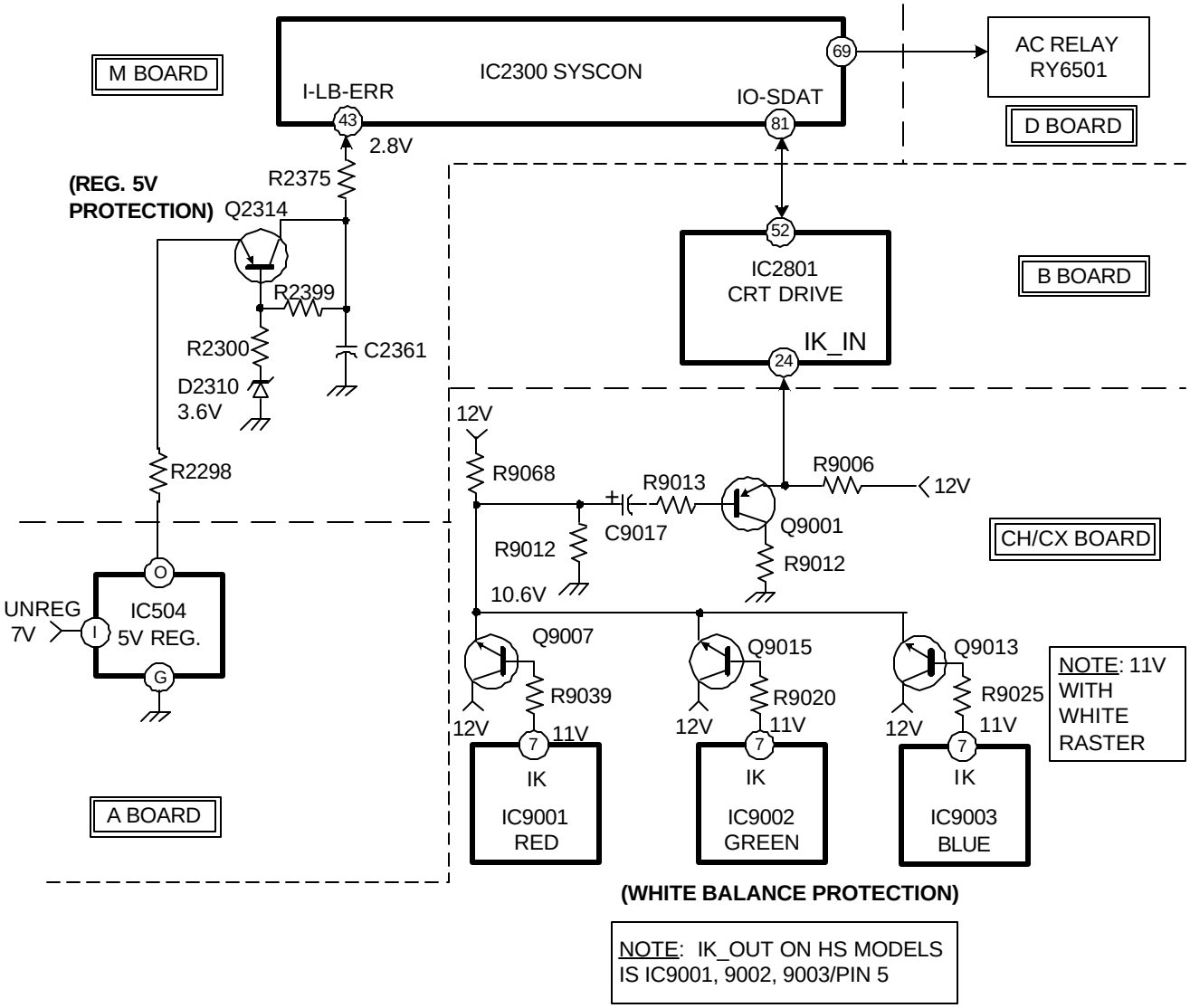


FIGURE 4-5 - DA-4 REG. 5V AND WHITE BALANCE PROTECTION CIRCUITS C31P15-4-5 10/28/02

Regulated 5V Protection Circuit

(Reference Figure 4-5)

The regulated 5V line is monitored using Q2314 and Zener diode D2310 (3.6V) on the M-board. The output of the 5V regulator IC504 is applied to the emitter of Q2314. In normal operation Q2314 is turned ON and D2310 is conducting, holding the base at 3.6V. Approximately 2.8V is applied to System Control IC2300/pin 43, indicating proper level of the regulated 5V line.

If the 5V line falls below approximately 4.5V at the emitter of Q2314, D2310 will stop conducting, Q2314 will turn OFF and a Low will be applied to IC2300/pin 43. IC2300/pin 69 will then turn OFF the AC relay.

The AC relay shuts down and the Stby/Timer LED flashes a **6X sequence.**

White Balance Protection Circuit (IK Protection)

(Reference Figure 4-5)

The condition of each CRT cathode (RGB) must be monitored in order to maintain optimal white balance. Each cathode is monitored by the individual driver IC9001, 9002 and 9003 on the CH/CX board. Each driver IC9001/ pin 7, IC9002/pin 7 and IC9003/pin 7 develops an IK feedback pulse, which is directly proportional to the current drawn by each cathode in the CRT. The IK feedback pulse passes through buffer transistors Q9007, Q9015 and Q9013, and then the sequence of the three IK feedback pulses is applied to the base of buffer Q9001.

The three IK feedback pulses are sequentially fed into IC2801/pin 24 and monitored for amplitude variations. If the IK feedback pulse is Low in amplitude or is missing, this indicates a weak or defective cathode. IC2801/pin 24 will detect this condition and the unit will go into IK protection mode.

The TV video is muted, the AC relay will remain ON and the Stby/Timer LED flashes a **5X sequence.**

DA-4X Protection Circuits

Overall Block Diagram

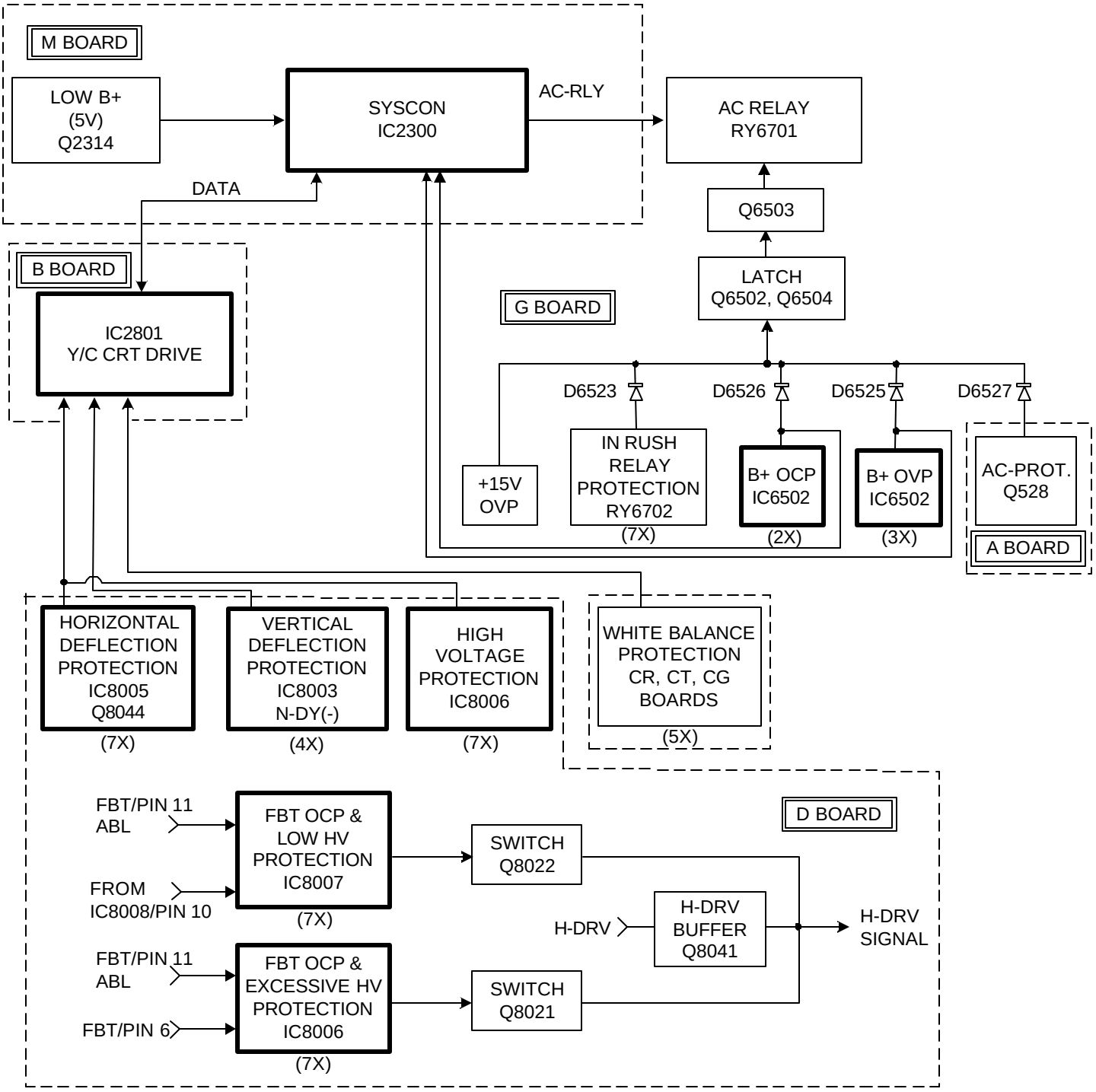


FIGURE 4-6 - DA-4X PROTECTION CIRCUITS OVERALL BLOCK C31P15-4-6 10/28/02

Figure 4-6 is a basic block diagram illustrating the interconnection of the protection circuit, System control and the AC relay. Also shown on the diagram is the Standby/Timer LED flash sequence for when the particular protection circuit is triggered (e.g. 4X will occur with a vertical deflection failure). Each protection circuit will be discussed in greater detail in coming diagrams. The purpose for each protection circuit is indicated by the name of the particular block.

(Reference Figure 4-6)

Q2314 monitors the 5V dc level. If the dc level falls below 4.5V, Q2314 detects this error and the AC input is disconnected.

RY6702 is used to remove the Inrush Current resistor from the AC input circuit after initial set turn-on. If the relay failures to activate, AC input is disconnected.

IC9101, 9201 and 9301 on the CR/CB/CG boards are the cathode drive ICs. Each IC produces a separate IK pulse directly proportional to the current in each cathode. The current in each cathode indicates the physical condition of the cathode. Depending on the cathode condition, the set will either increase RGB drive to the cathode or go into IK Protection mode.

+15V OVP monitors the 15V line for excessive voltage condition.

IC6502 is used to monitor both +135V OVP and OCP conditions.

Q528 on the A-board. If AC is not present at the input to the Standby 5V circuit, Q528 will activate the Latch and shut down the TV.

IC8005 and Q8044 monitor the horizontal deflection operation.

IC8003 and V-DY(-) IC8003 is the vertical drive IC that drives the deflection yoke (DY). The low side of the deflection yoke is monitored for proper vertical operation.

IC8006 and IC8007 monitor three separate circuits: Low HV, Excessive HV and FBT OCP.

DA-4 Direct AC-Relay Shut-Off Protection Circuits

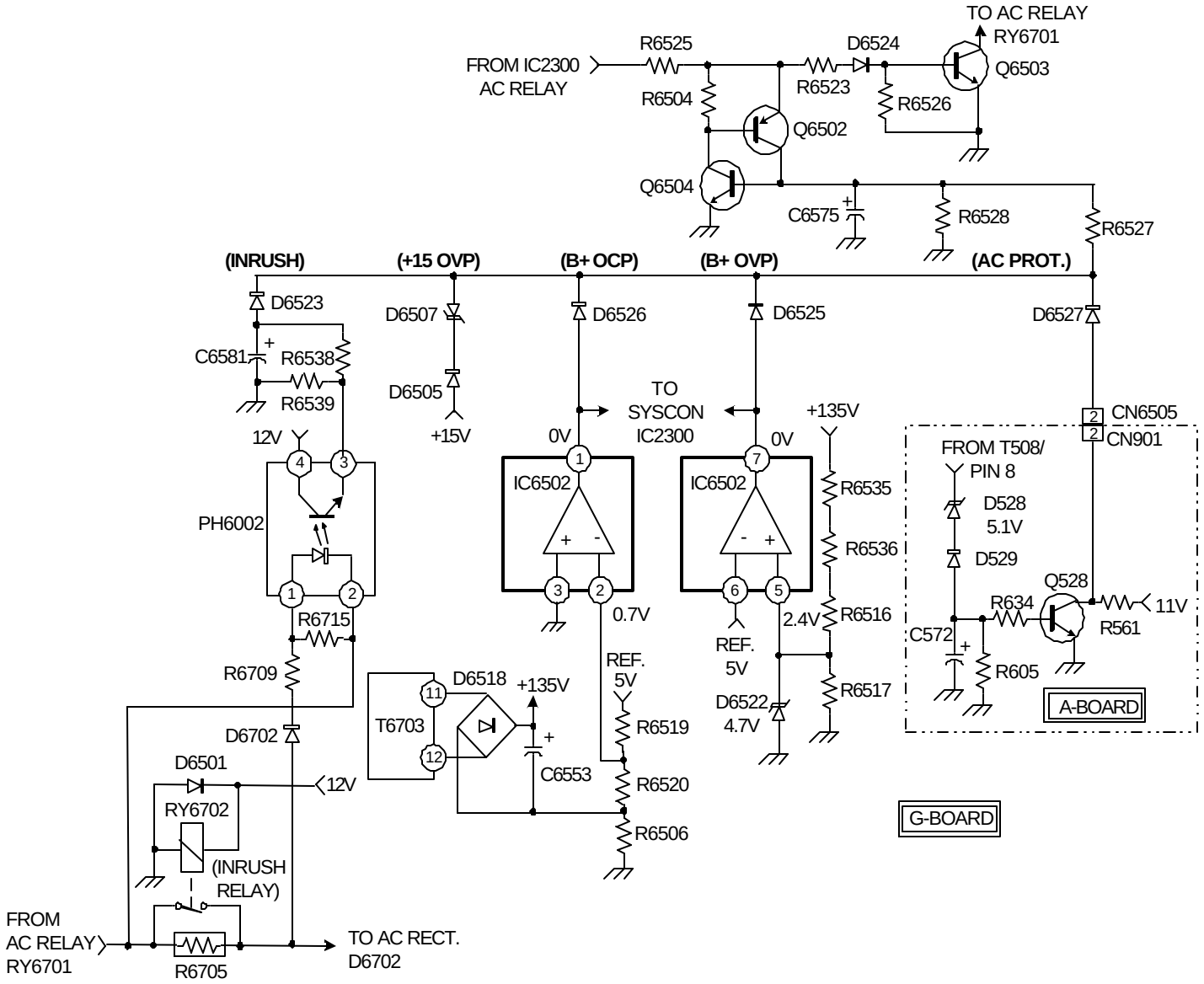


FIGURE 4-7 - DA-4X DIRECT AC RELAY SHUT-OFF PROTECTION CIRCUIT C31P15-4-7 1520 11/15/02

Inrush Current Relay Protection Circuit

(Reference Figure 4-7)

The current rating of the AC relay (RY6701) is 117mA at 153VAC. To keep the current below 117mA, resistor **R6705 (Inrush Current Resistor)** is in series with the AC input during the initial power-up of the TV. After the initial power-up current surge, R705 is bypassed when **RY6702 (Inrush Relay)** is energized and the switch is closed.

The operation of RY6702 is monitored using **R6705 and PH6002**. If RY6702 does not function, a voltage drop will develop across R6705, which in turn develops a voltage across R6715. The voltage across R6715 turns on the LED and 11V is output on PH6002/pin 3. **D6523** is now forward biased and a High is applied to the base of Q6504 turning it ON, which then applies a Low to the base Q6502 turning it ON. **Q6504 and Q6502 is a latching circuit.**

Once the latch is activated, the voltage at the base of Q6503 is reduced and it turns OFF, removing the ground path for the AC Relay and it turns OFF. The TV shuts down and the Stby/Timer LED flashes a **7X sequence**

+15 OVP

(Reference Figure 4-7)

The circuit monitoring the condition of the +15V line is a simple 20V zener diode. If the +15V line increases above 20.6V, the Latch will be activated and the AC relay will be shut OFF.

B+OCP

(Reference Figure 4-7)

The current is monitored in the +135V line using resistor R6506 located in the ground-side of the +135V circuit. If the current increases in the +135V line, the current through R6506 will also increase, but because of the direction of the current through R6506, a negative voltage is developed an IC6502/pin 2. IC6502/pin 3 (Grnd) will be now more positive then the negative IC6502/pin 2. a High is produced at IC6502/pin 1 and D6526 is forward biased. The latch is activated and the AC relay is turned OFF. Note that the High from IC6502/pin1 is also sent to System Control IC2300 to activate self-diagnostics.

B+OVP

(Reference Figure 4-7)

The B+ OVP circuit monitors the voltage level of the +135V through the voltage divider network consisting of R6535, R6536, R6516 and R6517. If the +135V should rise, so will the voltage drop across R6517and the voltage at IC6502/pin 5. Once the voltage at IC6502/pin 5 goes more positive then IC6502/pin 6, a High will be produced at IC6502/pin 7 and D6525 will be forward biased. The Latch will activate and the AC relay will be shut OFF. Note that the High from IC6502/pin7 is also sent to System Control IC2300 to activate self-diagnostics.

AC PROT

(Reference Figure 4-7)

The AC input to the Standby 5V circuit is monitored through D528, D529 and Q528. In normal operation D528 is in break-over mode and Q528 in turned ON. If the AC input is missing, Q528 will turn OFF and a High will forward bias D6527. the Latch will be activated and the AC relay will be shut OFF.

DA-4X Horizontal, Vertical, IK, and HV Protection Circuits

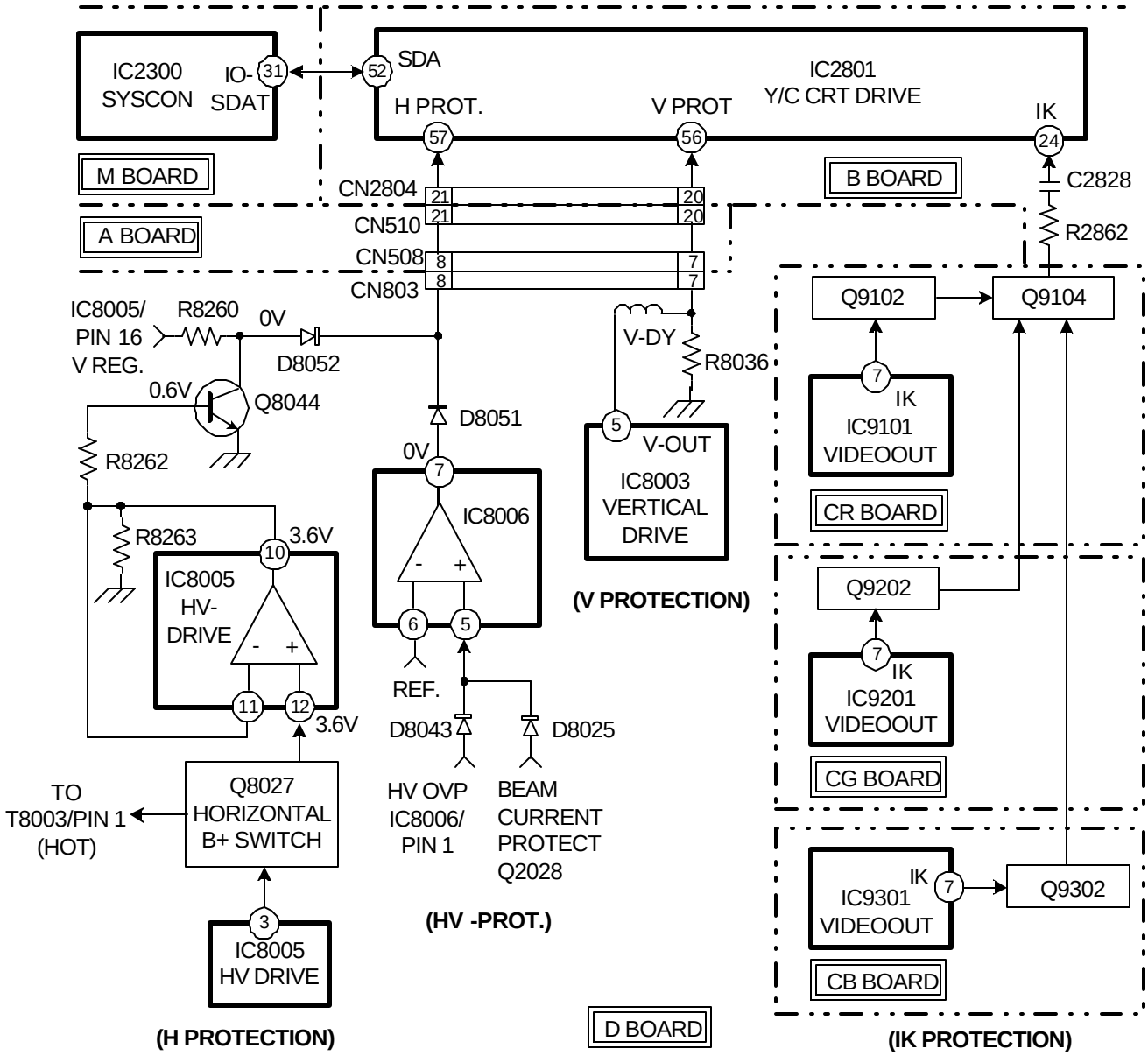


FIGURE 4-8 - HORIZONTAL, VERTICAL, IK, AND HV PROTECTION CIRCUIT C31P15-4-8 1522 11/4/02

Horizontal Deflection Protection Circuit

(Reference Figure 4-8)

The horizontal pulse output at IC8005/pin 3 drives the +135V regulator transistor Q8027, which drives T8003/pin 1 (HOT). A sample of the horizontal pulse is taken from the terminal of Q8027, which is applied to buffer IC8005/ pin 12 and then to the base of Q8044. As long as the horizontal pulse is present at the base of Q8044, a low is present at the collector.

If the horizontal deflection should stop the signal at the base of Q8044 will stop and a High will be produced at the collector of Q8044, which will forward bias D8052. A High will now be applied to IC2801/pin 57 to blank the video, and IC2801/pin 52 will communicate with IC2300/pin 31 and shut off the AC relay.

The standby/timer LED will flash a 7X sequence.

HV Protection

(Reference Figure 4-8)

Also attached to the H-Prot. input IC2801/pin 57 is the HV-PROT. This circuit is actually monitoring two functions: HV OVP and Beam Current through D8043 and D8025 respectively. If an excessive HV or Beam current condition should occur, IC8006/pin 5 will go High, which will cause IC8006/pin 7 to output a High. The High will forward bias D8051 and a High will now be applied to IC2801/pin 57 to blank the video. IC2801/pin 52 will then communicate with IC2300/pin 31 and shut off the AC relay. **The standby/timer LED will flash a 7X sequence.**

Vertical Deflection Protection Circuit

(Reference Figure 4-8)

IC2801/pin 56 monitors the low side of the vertical deflection coil [V-DY (-)]. IC8003/pin 5 drives the high side of the V-DY, while the other side goes to ground through R8036. A small vertical feedback signal is developed across R8036, which is applied to IC2801/pin 56.

If the vertical deflection circuit should fail (no drive to V-DY), IC2801/pin 56 will detect the missing vertical feedback signal and blank the video output to the CRT. The TV will be placed in Vertical shutdown and the **standby/timer LED will flash a 4X** sequence. **The AC Power and Audio will remain ON.**

IK (White Balance) Protection Circuit

(Reference Figure 4-8)

Each CRT driver IC9101, 9201 and 9301/pin 7 (located on the CR, CG, and CB boards) produces an IK feedback pulse directly proportional to the current in each cathode (which indicates the condition of the cathode). All three IK feedback pulses are combined at Q9104 on the CR board and sent back sequentially to IC2801/pin 24.

Each pulse is monitored for level by IC2801/pin 24. If a pulse is low, IC2801/pin 52 will detect a weakened cathode and IC2801 will increase the drive signal to that weakened cathode until optimal white balance is achieved. If white balance cannot be achieve within two seconds then IC2801/pin 52 will communicate with IC2300/pin 31 and the TV will go into IK protection mode. **The video to the CRT will be blanked and the standby/timer LED will flash a 5X sequence. The AC power and Audio will remain ON.**

DA-4X HV OVP, and FBT OCP Protection Circuits

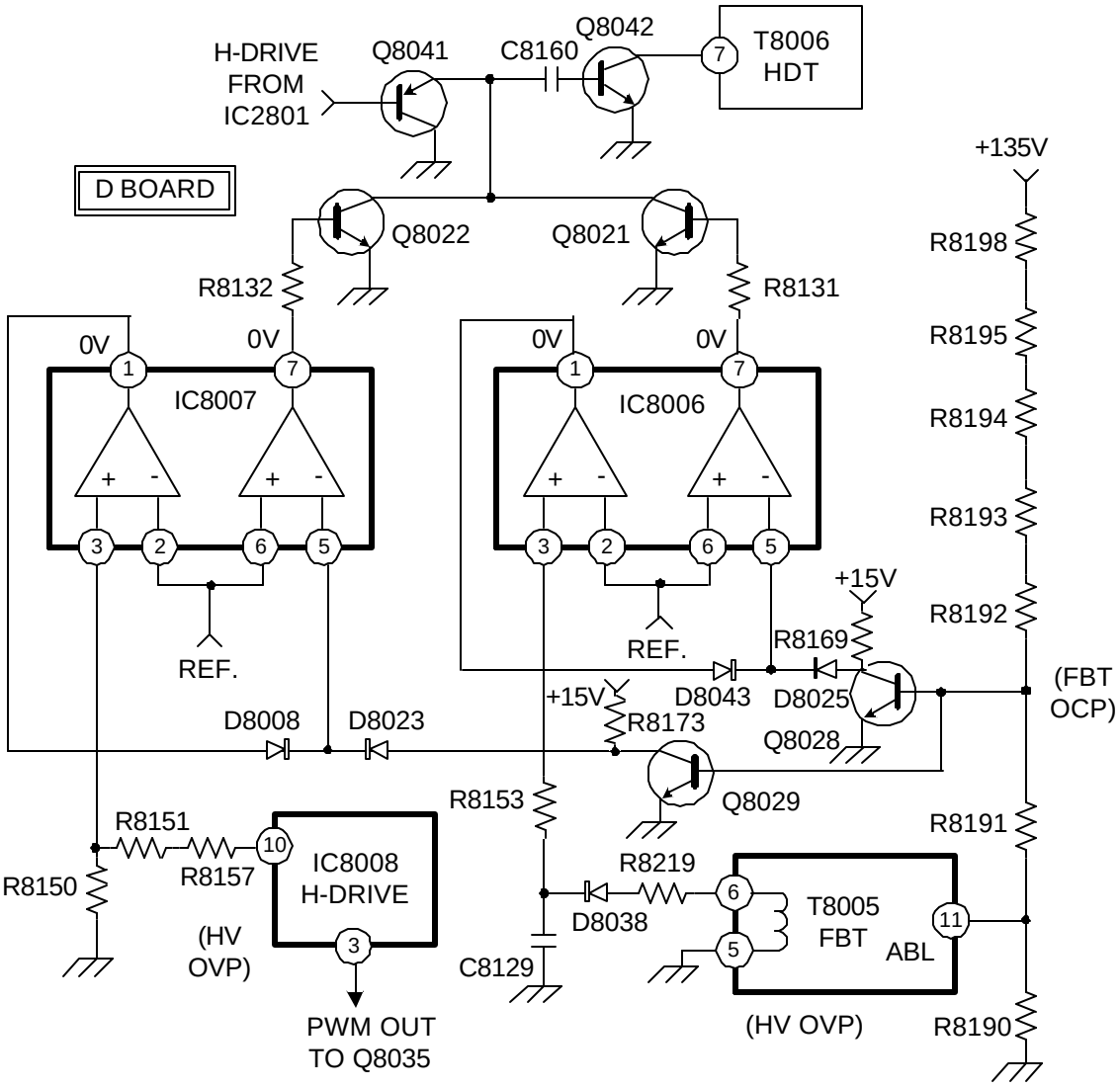


FIGURE 4-9 - DA-4X HV OVP AND FBT OCP PROTECTION CIRCUITS

C31P15-4-9 10/28/02

HV OVP and FBT OCP (or Beam Current) Protection Circuit

HV level and current are monitored by IC8006 and IC8007. They will stop high voltage generation to provide protection for the HV components, CRTs and X radiation level. This is accomplished by disabling the H drive pulse from the video processor IC2801 (not shown).

IC8007/pin 3 monitors a sample of the HV coming from the HV Block. If the HV should increase, IC8007/pin 3 will become more positive then the reference at IC8007/pin 2 and IC8007/pin1 will output a High. D8008 will now forward bias and apply a High to IC8007/pin 5, and a High will be output at IC8007/pin 7. Q8022 will turn ON and a ground will be placed on the emitter of buffer Q8041, stopping the H drive signal to T8006 and thus stopping HV output.

IC8007/pin 5 can also be triggered through D8023. D8023 will be forward biased when an excessive beam current condition exists in the CRT. The current in the FBT is monitored using the ABL voltage at FBT/pin 11. A reference voltage is developed using the +135V and the voltage divider consisting of R8198, R8195, R8194, R8193, R8192, R8191 and R8190. The combined voltage drop across R88191 and R8190 is used to turn off Q8029 and trigger the protection circuit. In normal operation, 0.6V is applied to the base of Q8029 turning it ON and a Low is present at the collector. A High at the collector is needed to activate the protection mode.

As the current in the FBT secondary increases, the ABL line will pull increasingly more current through the voltage divider network at the top of R8190 and less current will flow through R8190. The voltage drop across R8190 will decrease, causing the combined voltage drop across R8191 and R8190 to decrease. At the same time, the 0.6V at the base of Q8029 is decreasing, which turns OFF Q8029. A High will now be developed at the collector through pull-up resistor R8173. **D8023** is now forward biased and a High is applied to IC8007/pin 5. A High will now be output at IC8007/pin 7 and Q8022 will turn ON and stop H drive at the emitter of Q8041, stopping the HV.

IC8006/pin 5 has the identical function as that of IC8007/pin 5 just described. These are backup FBT OCP protection circuits protecting against excessive beam current in the CRT. IC8006 uses Q8021 switch to stop H drive at the emitter of Q8041.

IC8006/pin 3 protects against excessive HV the same as IC8007/pin 3. The difference between the two circuits is where the HV is monitored. IC8007/pin 3 monitors HV at the HV Block whereas IC8006/pin 3 monitors the HV using a coil in the primary side of the FBT located at FBT/pins 5 and 6. The output at FBT/pin 6 is directly proportional to the HV. If HV increases, so will FBT/pin 6. The output is rectified, filtered and applied to IC8006/ pin 3. The function after a High is applied to IC8006/pin 3 is identical to IC8007/pin 3 described above except Q8021 is used to stop the H drive at the emitter of Q8041.

The Standby/Timer LED flashes a **7X sequence** when a failure occurs**.**

Regulated 5V Protection Circuit

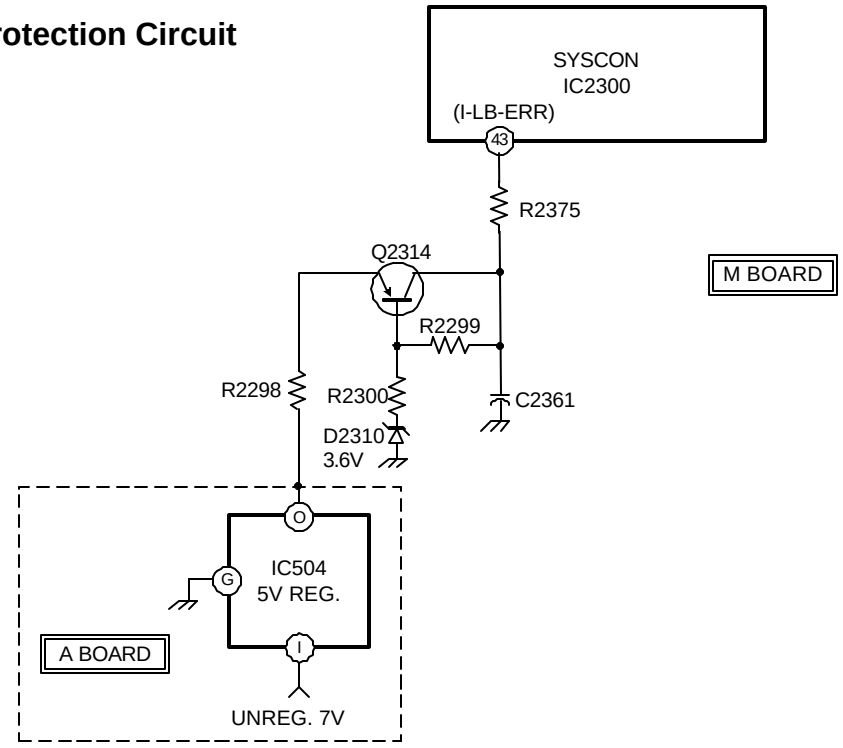


FIGURE 4-10 - REGULATED 5V PROTECTION CIRCUIT C31P15-4-10 11/12/02

(Reference Figure 4-10)

The regulated 5V line is monitored using Q2314 and Zener diode D2310 (3.6V) on the M-board. The output of the 5V regulator IC504 is applied to the emitter of Q2314. In normal operation, Q2314 is turned ON and D2310 is conducting holding the base at 3.6V. Approximately 2.8V is applied to System Control IC2300/pin 43 indicating proper level of the regulated 5V line.

If the 5V line falls below approximately 4.5V at the emitter of Q2314, D2310 will stop conducting, Q2314 will turn OFF and a Low will be applied to IC2300/pin 43. IC2300/pin 69 will then turn OFF the AC relay.

The AC relay shuts down and the Stby/Timer LED flashes a **6X sequence.**

Chapter 5 - DA-4 & DA-4X Video Processing

DA-4 and DA-4X Acceptable Formats

The acceptable inputs for these chassis are listed in Table 5-1:

Table 5-1 - DA-4 and DA-4X Inputs

Inputs	Format
Analog TV stations	Air (Ch. 2-69) or Cable (1-125) NTSC
Video 1-4	S or Composite Video (480i)
Video 5-6	Component Video (Y,PB,PR) 480i, 480p, 720p, or 1080i
Video 7 (DVI)	Digital 1080i

Overall Block Diagram

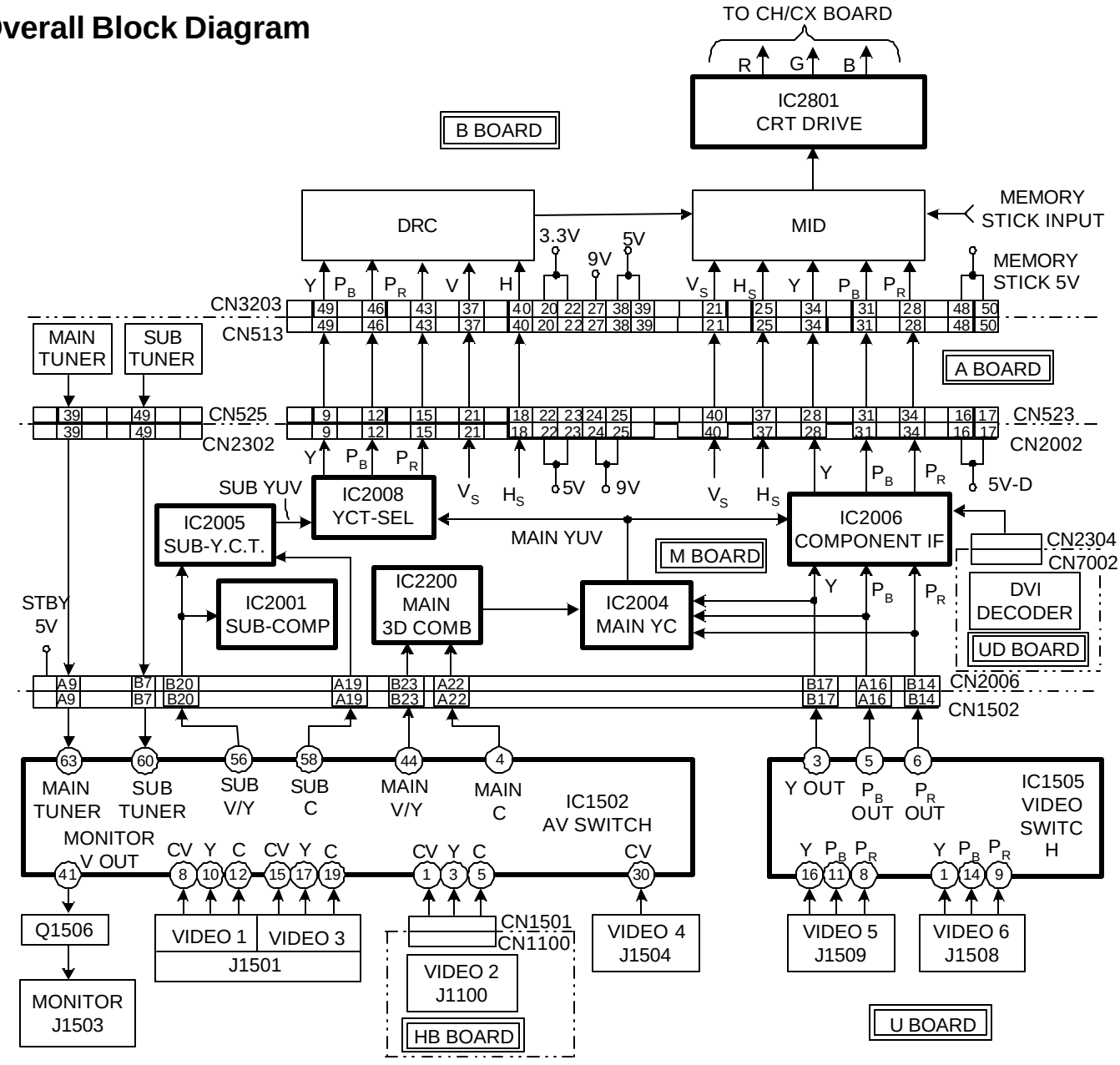
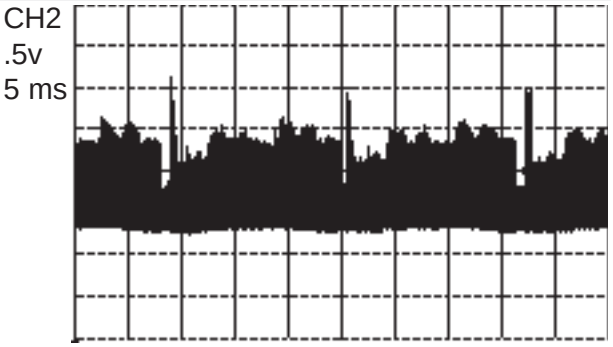


FIGURE 5-1 - DA-4 & DA-4X VIDEO PROCESSING BLOCK C31P15-5-1 10/15/02

Video Processing Circuit Description

(Reference Figure 5-1)

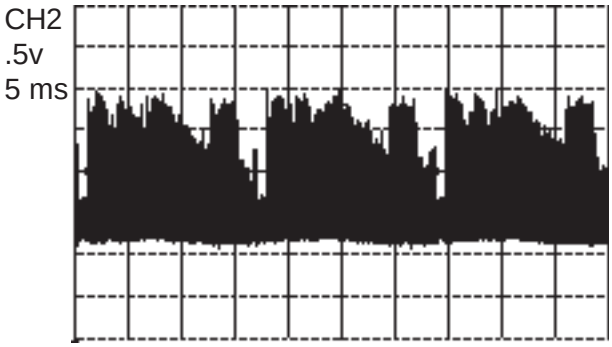
The **Main and Sub Tuners** are located on the A board. The video path is through the M board for each tuner starting at the A board CN525/pins 39 and 49, which connects to the B board CN2302/pin 39 and 49; CN2006/pins A9 & B7 (B board) then connects to CN1502/pins A9 and B7 (U board). The video is then input to IC1502/ pin 63 (Main) and IC1502/pin 60 (Sub) the AV Switcher.



Waveform 5-1
Sub and Main Tuner Video Output

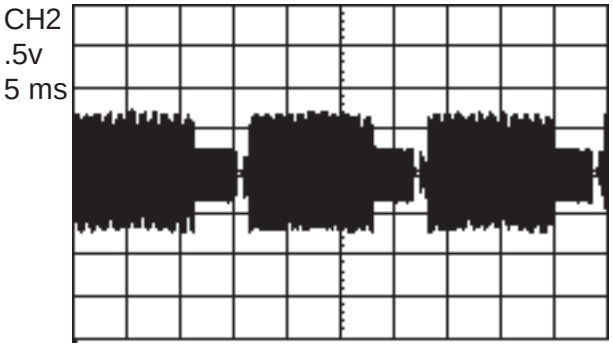
The Sub video input is selected by IC1502 and the Main video is selected by either IC1502 or IC1505. Once the inputs are selected, the Sub video is output at IC1502/pins 56 (V/Y) and 58 (C), and Main video is output at IC1502/pins 44 (V/Y) and 47 (C) or IC1505/pins 3,5 and 6 (Component).

Video inputs 1, 3 and 4 are all located on the U board and are connected directly to IC1502 (as shown in Figure 5-1). **Video input 2** is located on the HB board on the front of the TV and is also connected directly to IC1502. Video inputs 1, 2, 3 and 4 can accommodate either **Composite video or S-Video**. The Sub and Main composite outputs (Waveform 5-2) can be viewed on the U-board CN1502/pins B20 (Sub) and B23 (Main).



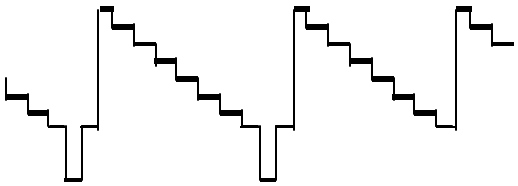
Waveform 5-2
Sub and Main Video Output

The Sub and Main color signal outputs can be viewed on the U-board CN1502/pins A19 (Sub) and A22 (Main) reference Waveform 5-3.

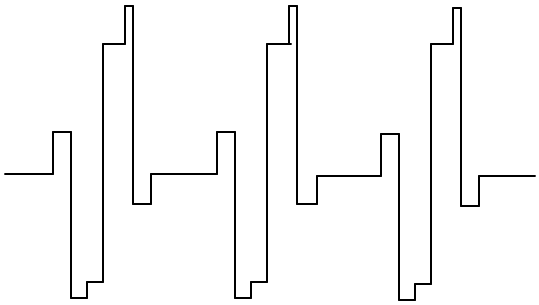


Waveform 5-3
Sub and Main Color Signal Output

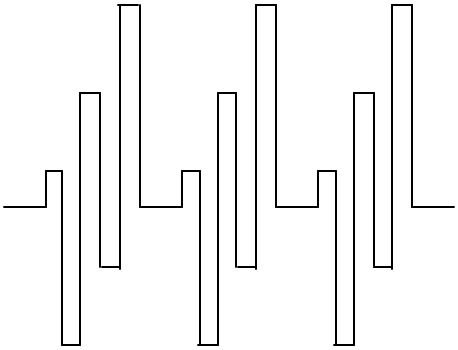
Video inputs 5 and 6 are also located on the U board, but are connected to **IC1505 Video Switch**. Video inputs 5 and 6 are **component inputs**. The component signal outputs from IC1505 can be viewed at Cn1502/ pins B17 (Y), A16 (PB) and B14 (PR) reference Waveforms 5-4 and 5-5.



WAVEFORM 5-4
WAVEFORM Y SIGNAL 1.3Vp-p (H)



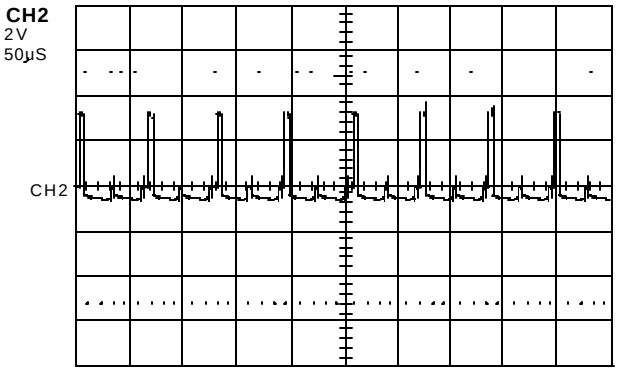
WAVEFORM 5-5
WAVEFORM P_R SIGNAL 1.3Vp-p (H)



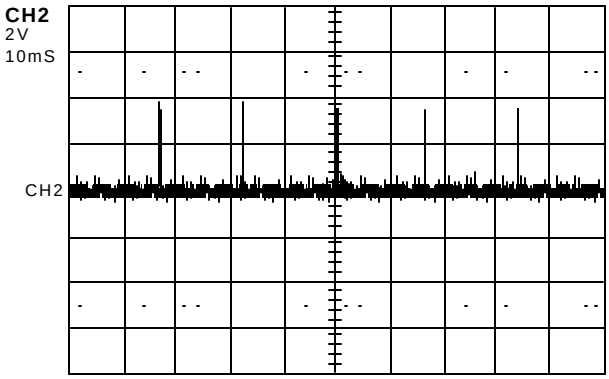
WAVEFORM 5-6
WAVEFORM P_B SIGNAL 1.3Vp-p (H)

Note: These same component signals will also be present at CN2002/pins 9 (Y), 12 (PB), 15 (PR) for Sub and Main video inputs, and CN2002/pins 28 (Y), 31 (PB), 34 (PR) for the component input for signal tracing.

The Horizontal (HS) and Vertical (HS). Sync. Input signals for both DRC and MID can be viewed at CN2002/pin 21 (DRC VS), CN2002/pin 18 (DRC HS), CN2002/pin 40 (MID VS) and CN2002/pin 37 (MID HS). (Reference Waveforms 5-7 and 5-8 for VS and HS waveforms)



Waveform 5-7
Horizontal Sync



Waveform 5-8
Vertical Sync

All the video signals pass through the A-board unprocessed and are then applied to the B-board through CN2002 (A-board) and CN3203 (B-board). All video processing is performed on the B-board (DRC and MID processing). The **DRC circuit** will double the horizontal frequency for input signals with 15.75KHz (NTSC) horizontal inputs. The MID circuit will up-convert the horizontal frequency of the input signal to 33.75KHz, which is the scan rate of the DA-4 and DA-4X chassis. Table 5-2 shows the signal standard and its associate horizontal frequency.

Table 5-2 - Input Signal Standard and Horizontal Frequency

Input Signal	Horizontal Frequency
Standard NTSC 480i	15.534KHz
High Resolution 480p	31.5KHz
High Resolution 720p	45KHz
High Resolution 1080i	33.75KHzz

The following is a description of the signal flow for each standard listed in Table 5-2:

- **15.734KHz input:** DRC circuit up-converts to 31.5KHz and MID circuit up-converters to 33.75KHz
- **31.5KHz input:** MID circuit up-converts to 33.75KHz
- **33.75KHz input:** XBR, HV pass through MID; HS bypass MID circuit
- **45KHz input:** MID circuit down-converts to 33.75KHz

The output of the MID circuit is then applied to the CRT drive IC2801, which will then drive the CH/CX boards in the DA-4 (shown in Figures 5-2 and 5-3, and CR, CG, CB boards in the DA-4X chassis (boards not shown, but the circuit operation is same as Figure 5-2).

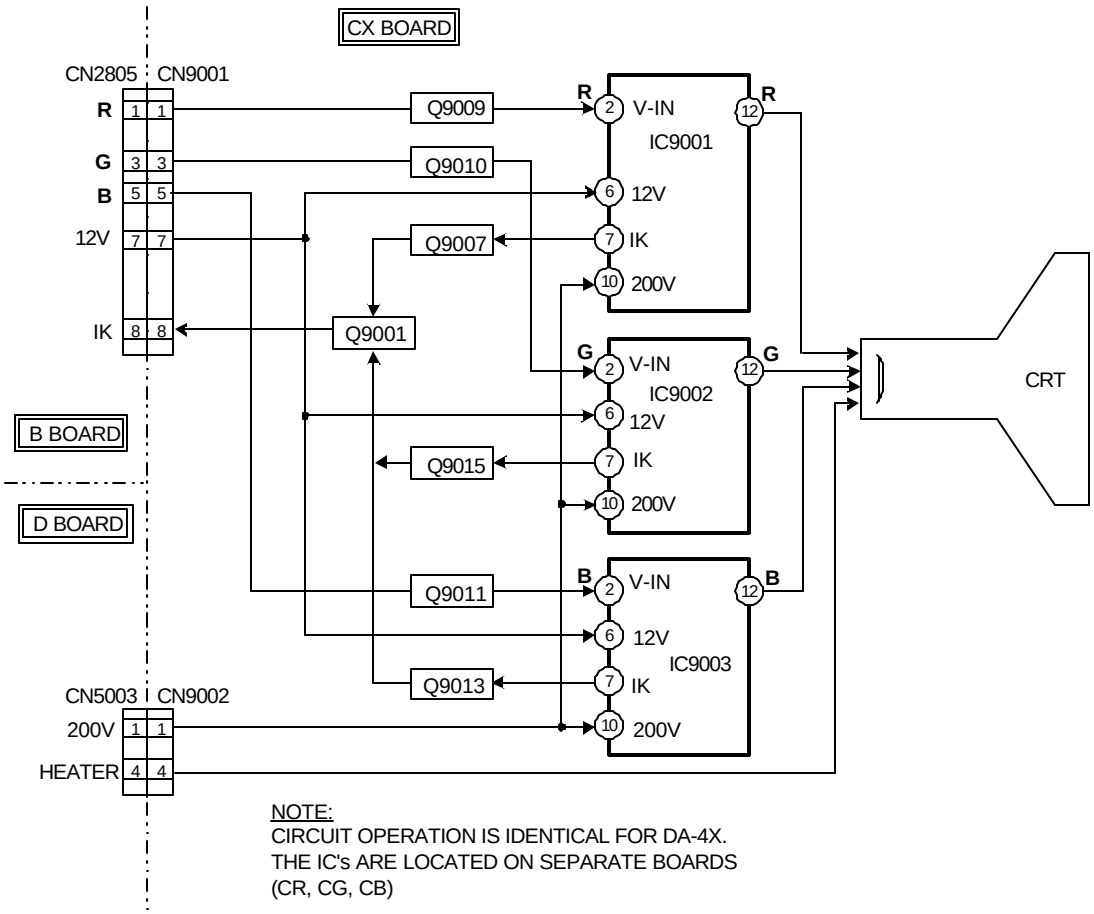


FIGURE 5-2 - DA-4 CX BOARD (HV & XBR) C31P15-5-2 1524 11/12/02

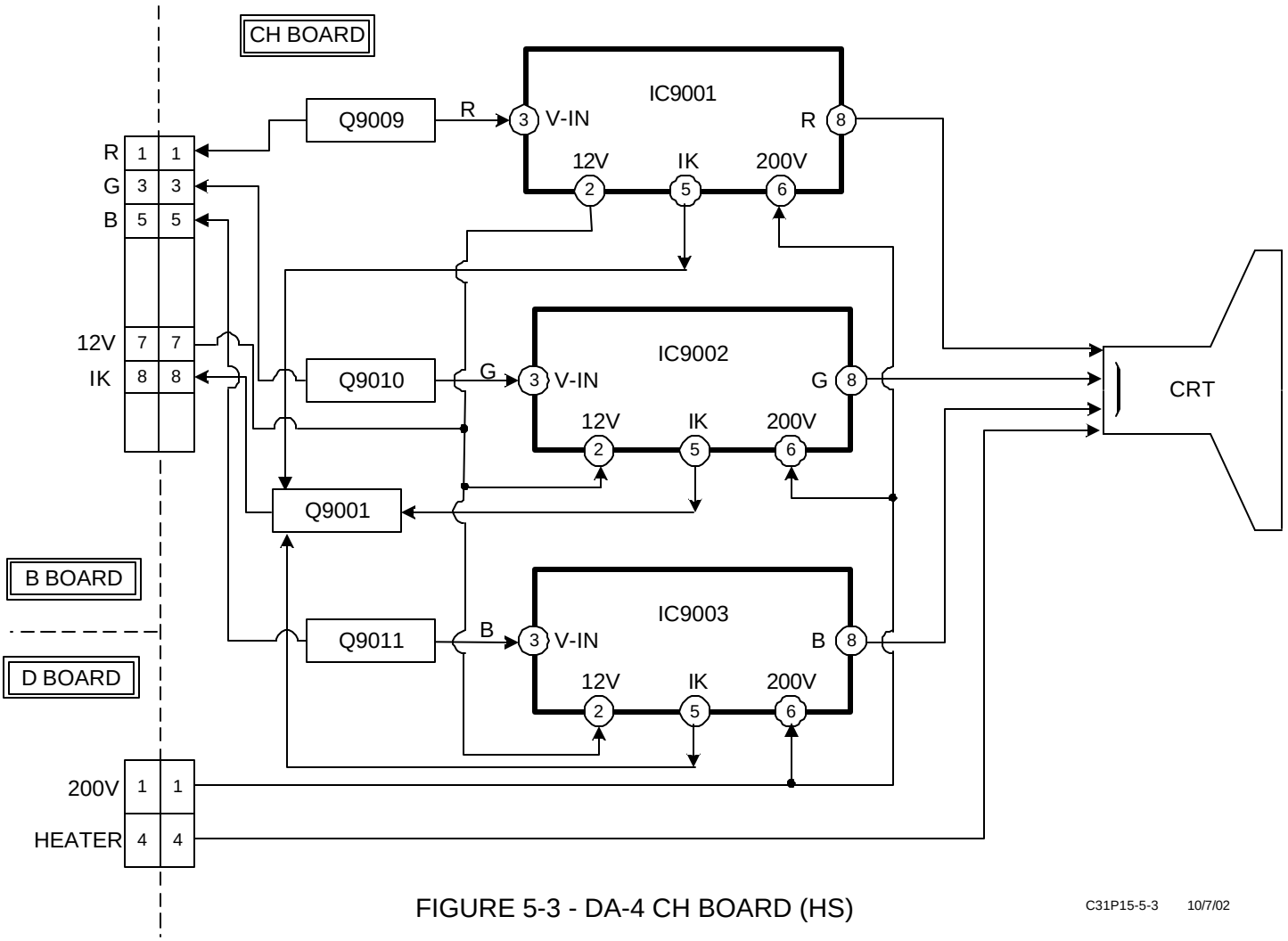


FIGURE 5-3 - DA-4 CH BOARD (HS) C31P15-5-3 10/7/02

Troubleshooting (Board Level)

(Reference Figure 5-1)

The DA-4 and DA-4X chassis's video processing circuits can be evaluated to board level simple by using the various inputs. The following is a list of inputs versus the circuits active for that particular input.

Video Inputs 1-4: (480i Input)

IC1502 AV switch (U-board)

IC2001 and IC2200 Comb. (M-board)

IC2005 and IC2004 YCT (M-board)

IC2008 (M-board)

DRC circuit (B-board)

MID circuit (B-board)

IC2801 CRT Drive (B-board)

Video Inputs 5 and 6: (1080i Input)

IC1505 Video Switch (U-borad)
IC2006 Component I/F (M-board)
MID circuit (B-board)
IC2801 CRT Drive (B-board)

Note: 480i will add the DRC circuit before the MID circuit.

DVI Input

IC1505 Video Switch (M-board)
MID circuit
IC2801 CRT Drive (B-board)

Memory Stick Input:

MID circuit (B-board)
IC2801 CRT Drive (B-board)

Note that by applying signals to the various inputs, complete circuits and boards can be bypassed to determine on which board the defective circuit is located. This is the most efficient way to troubleshoot the video processing circuits because the M and B boards are not field repairable.

EXAMPLES:

(Reference Figure 5-1)

1) The Memory Stick Input will bypass the U and M boards.
2) The DVI Input will bypass the U board.
3) The Video 1-4 and Video 5-6 inputs can be used to isolate a defect to either IC1502 or IC1505.

DA-4 Horizontal Deflection Circuit

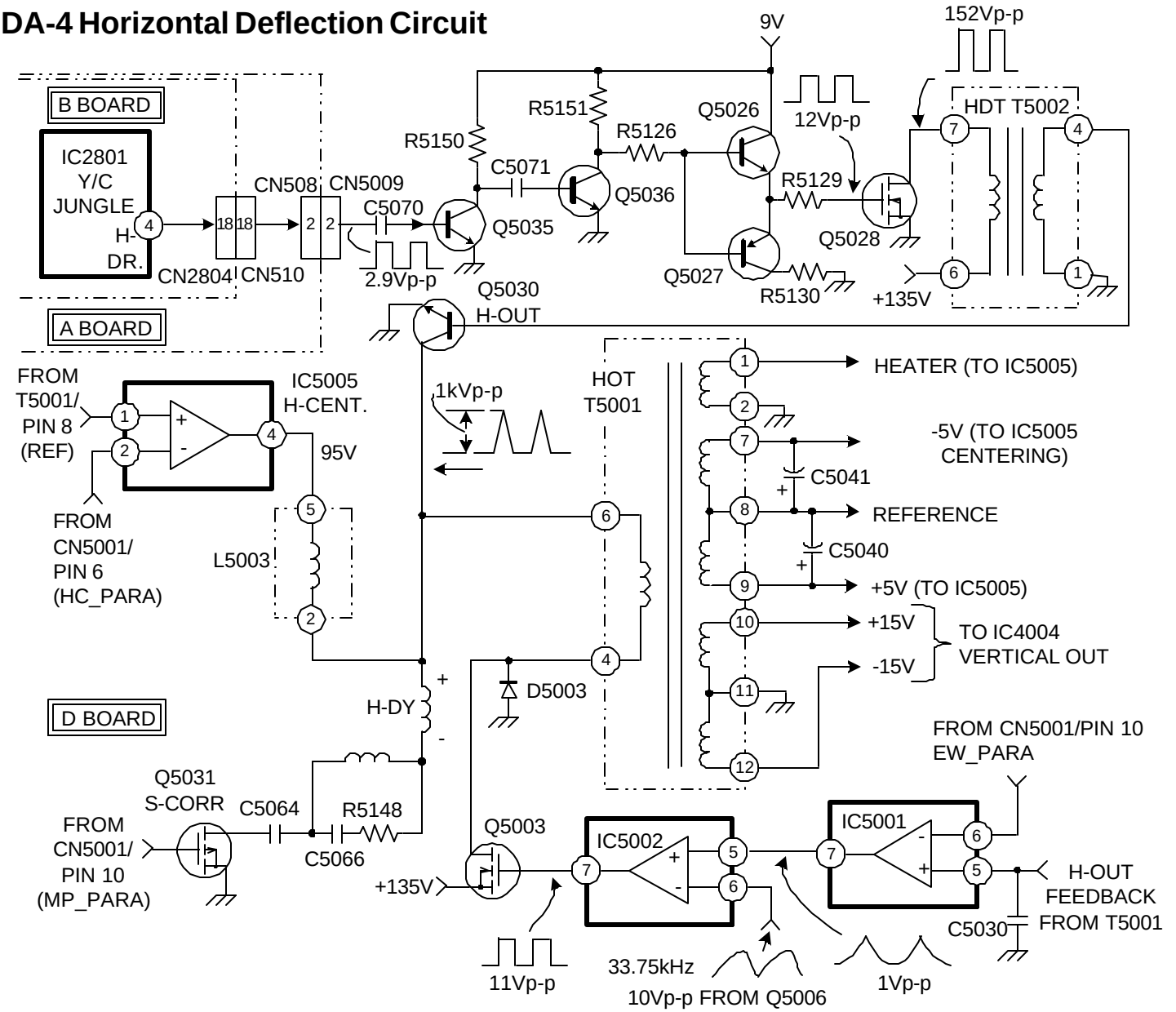


FIGURE 6-1 - DA-4 HORIZONTAL DEFLECTION CIRCUIT C3P15-6-1 1527 11/11/02

Horizontal Drive Circuit

(Reference Figure 6-1)

This circuit is split between an oscillator on the B-board and an output stage on the D-board. The 33.75KHz horizontal oscillator is in the Y/C Jungle IC2801. IC2801/pin 4 outputs a 3Vpp rectangular waveform (H-DRV). On the D-board, the H-DRV waveform is amplified through Q5035 and Q5036, and then applied to buffer Q5027.

The MOSFET driver Q5028 and the output transistor Q5030 amplify the signal to provide sufficient current to drive the HOT T5001 and the H-DY deflection yoke.

At the output stage, the HOT T5001 has a secondary winding that provides filament voltage, and also +/-15V for the vertical driver IC5004 and the horizontal centering circuit IC5005.

The waveforms shown on Figure 6-1 are the typical horizontal circuit signal shapes. The difference between this set and a conventional set is the horizontal frequency, which is 33.75KHz as opposed to 15.75KHz scan rate in the conventional set. The 33.75Khz scan rate is considered a high definition horizontal scan rate.

PWM Circuit

(Reference Figure 6-1)

The PWM circuit (Q5003) has two functions. First, it provides a regulated 102Vdc output for the horizontal output transistor Q5030. Second, it compensates for horizontal pincushion affect and keeps the picture vertical edges straight.

Regulator

The PWM circuit regulates +135Vdc from the power supply down to +102Vdc. Horizontal pulses from IC8004/ pin 1 (not shown in Figure 6-1) in the HV power supply section drive Q5003. The pulses are amplified and output to the HOT T5001/pin 4. To control the output voltage, the output is sampled and used to change the pulse width of the H drive pulses. These changes regulate the output voltage to +102Vdc at T5001/pin 4.

Pincushion Correction

If the PWM output voltage at T5001/pin 4 were changed, the horizontal picture size would vary accordingly. A vertical pincushion signal is produced at IC2801/pin 11 (not shown) and is applied to the PWM circuit to increase the picture width and compensate for the pincushion distortion.

The EW_PARA parabola signal form CN5001/pin 1 (D-board) is first applied to IC5001/pin 6 and output on IC5001/pin 7, and then applied to IC5002/pin 5. The parabola signal at IC5002/pin 5 is compared to the sawtooth waveform at IC5002/pin 6. This comparison causes the PWM signal at the output IC5002/pin 7 to vary in pulse width. The change in pulse width causes more or less voltage to be applied to the horizontal output Q5030 collector during the vertical scan down the CRT. This varying voltage causes a varying current to be applied to the H-DY. Current is gradually increased as the beam scans down until the current is maximum at the center of the CRT where the pincushion distortion is the most extreme. The result is a good, straight line scan down both sides of the CRT.

Heater Voltage

The filament voltage is applied when the horizontal oscillator signal produces horizontal sweep. The horizontal output transformer T5001/pin 1 outputs 7.7Vdc when power is ON. This voltage is regulated to 6.1Vdc by IC5006 to become the main filament voltage.

H-Centering and S-Correction

Also shown in Figure 6-1 is the H-Centering circuit. This circuit applies a small dc-offset to the H-DY to keep the picture centered on the CRT. This function is performed dynamically through the service mode by varying the parabola waveform at CN5001/pin 6 (HC_PARA). The HC_PARA after is applied to IC5005/pin 2 and a dc-offset is produce at IC5005/pin 4.

The **S-Correction** circuit is used to correct for the slight “S” shaped distortion that appears in each horizontal line. Once again this function is performed dynamically through the service mode by varying the parabola waveform at CN5001/pin 10 (MP_PARA).

DA-4 Vertical Deflection Circuit

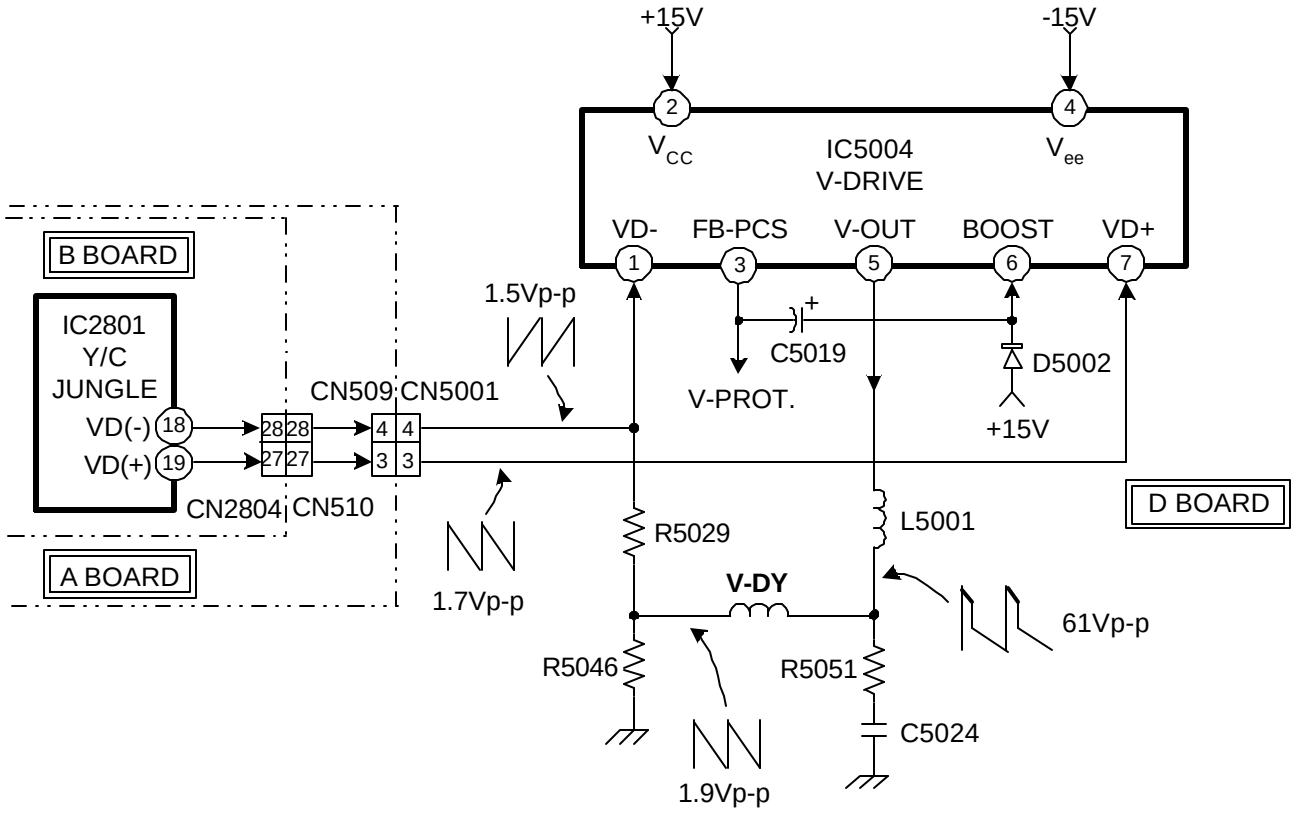


FIGURE 6-2 - DA-4 VERTICAL DEFLECTION CIRCUIT C31P15-6-2 1528 11/8/02

Vertical Drive

The vertical oscillator inside IC2801 starts and outputs ramp signals at IC2801/pin 18 (VD(-)) and IC2801/pin 19 (VD(+)) when power is applied. Data need not be present for vertical drive to output from IC2801.

The vertical stage is has not changed functionally from previous models. The vertical drive signals from IC2801/ pins 18 and 19 are applied to IC5004/pins 1 and 7. The ramp signals are amplified in IC5004 and the output drive for the V-DY is output at IC5004/pin 5.

DA-4X Horizontal Deflection Circuit

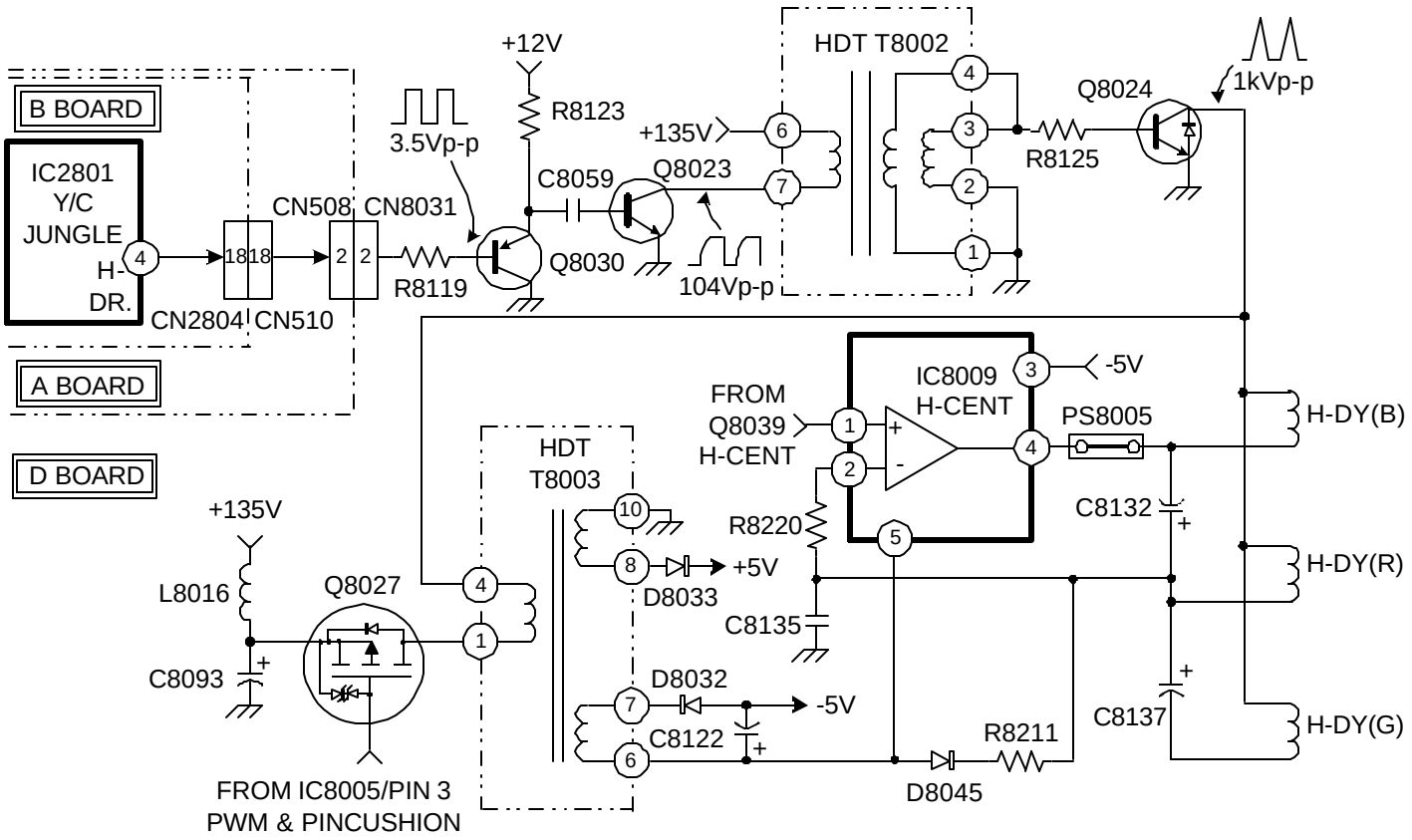


FIGURE 6-3 - DA-4X HORIZONTAL DEFLECTION C31P15-6-3 1529 11/8/02

Horizontal Drive Circuit

(Reference Figure 6-3)

The circuit is split between an oscillator on the B-board and an output stage on the D-board. The 33.75KHz horizontal oscillator is in the Y/C Jungle IC2801. IC2801/pin 4 outputs a 3Vpp rectangular waveform (H-DRV). On the D-board, the H-DRV waveform is amplified through Q8030 and Q8023, and then applied to T8002/pin 7.

The horizontal output transistor Q8024 amplifies the signal to provide sufficient current to drive the HOT T8003 and the H-DY deflection yoke.

At the output stage, the HOT T8003 has two secondary windings that provide +/-15V for the Dynamic Focus Q8007 and the Horizontal Centering circuit IC8009.

The waveforms shown on Figure 6-3 are the typical horizontal circuit signal shapes. The difference between this set and a conventional set is the horizontal frequency, which is 33.75KHz as opposed to 15.75KHz in the conventional set. The 33.75KHz is considered a high definition horizontal scan rate.

PWM Circuit

(Reference Figure 6-3)

The PWM circuit (Q8027) has two functions. First, it provides a regulated 102Vdc output for the horizontal output transistor Q8024. Second, it compensates for horizontal pincushion affect and keeps the picture vertical edges straight.

Regulator

The PWM circuit regulates +135Vdc from the power supply down to +102Vdc. Horizontal pulses from IC8005/ pin 10 (not shown in Figure 6-3) are used to drive Q8027 through IC8005pin 7 and output from IC8005/pin 3.

The pulses are amplified and output to the HOT T5001/pin 4. To control the output voltage, the horizontal output is sampled (IC8005/pin 12) and used to change the pulse width of the H drive pulses. These changes regulate the output voltage to +102Vdc at T5001/pin 4.

Pincushion Correction

If the PWM output voltage at T5001/pin 4 were changed, the horizontal picture size would vary accordingly. A vertical pincushion signal is produced at IC2801/pin 11 (not shown) and is applied to the PWM circuit to increase the picture width and compensate for the pincushion distortion.

The EW_PARA parabola signal form CN8025/pin 9 is first applied to IC8005/pin 6, which is used to drive the gate of Q8027. The parabola signal at IC8025/pin 6 is compared to the H-DRV feedback waveform at IC8025/pin 7. This comparison causes the PWM signal at the output IC8025/pin 3 to vary in pulse width. The change in pulse width causes more or less voltage to be applied to the horizontal output Q5030 collector during the vertical scan down the CRT. This varying voltage causes a varying current to be applied to the H-DY. Current is gradually increased as the beam scans down until the current is at its maximum at the center of the CRT where the pincushion distortion is the most extreme. The result is a straight-line (linear) scan down both sides of the CRT.

H-Centering Correction

Also shown in Figure 6-3 is the H-Centering circuit. This circuit applies a small positive and negative dc-offset to the Red and Blue H-DY respectively, to keep the picture centered with reference to the Green H-DY on the CRT. This function is performed dynamically through the service mode by varying the parabola waveform at CN8025/ pin 6 (HC_PARA), which is processed on the AD-Board, which produces the H-CENT signal at CN8027/pin 7. The H-CENT is applied to IC8009/pin 1 and a dc-offsets is produced at IC8009/pin 4 through PS8005.

DA-4X Vertical Deflection Circuit

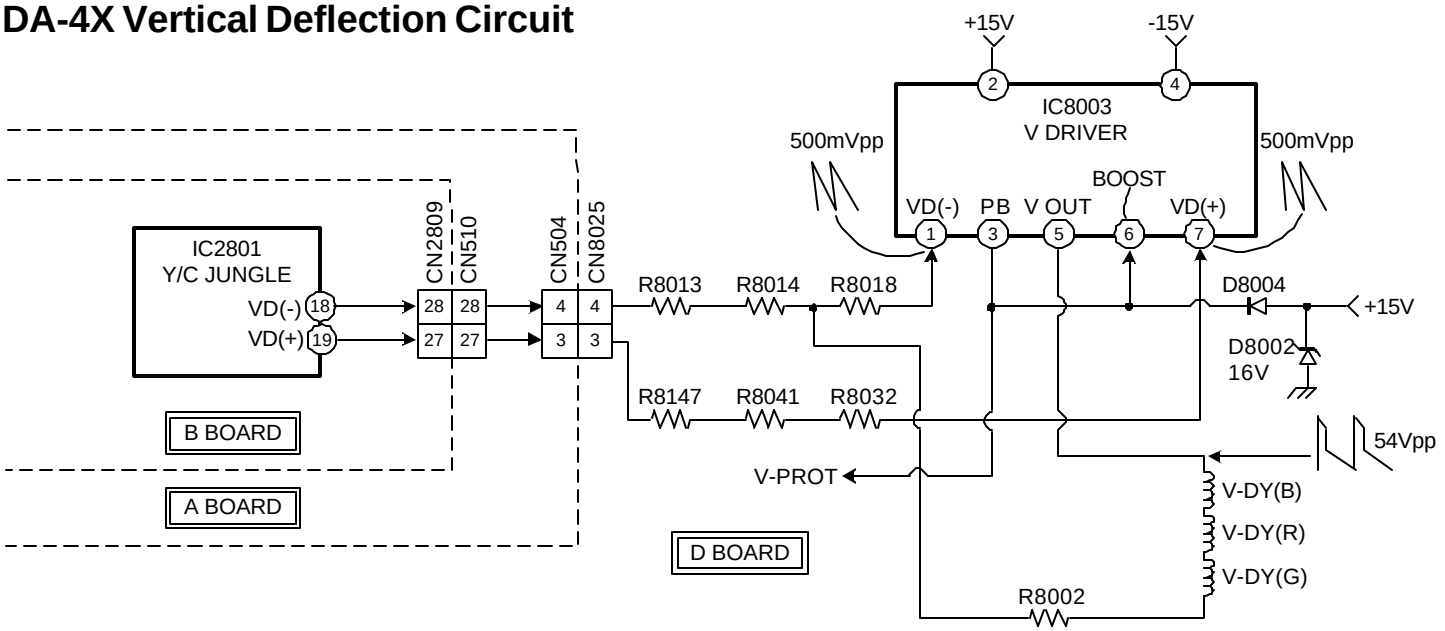


FIGURE 6-4 - DA-4X VERTICAL DEFLECTION CIRCUIT C31P15-6-4 10/7/02

Vertical Drive

(Reference Figure 6-4)

The vertical oscillator inside IC2801 starts and outputs ramp signals at IC2801/pin 18 (VD (-)) and IC2801/pin 19 (VD (+)) when power is applied. Data need not be present for vertical drive to output from IC2801.

The vertical stage has not changed functionally from previous models. The vertical drive signals from IC2801/ pins 18 and 19 are applied to IC8003/pins 1 and 7. The ramp signals are amplified in IC8003 and the output drive for the V-DY is output at IC8003/pin 5.

Chapter 7 - DA-4 & DA-4X Data Communication Bus Networks

There are three data communications networks used in the DA-4 and DA-4X chassis's. All three consist of data and clock lines, which communicate with multiple ICs. Refer to Table 7-1.

Table 7-1 - Data Communications Bus Networks		
Network	**Location**	**Purpose**
SDAT, SCLK	IC2300/pins 31,28 Main Micro	Overall System Control
BDAT, BCLK	IC2300/pins 30,29 Main Micro	NVM1 (IC2302) Control
DO, CO	IC3090/pins 95,97 MID Micro	MID Processing Control

DA-4 and DA-4X Data Communications Diagram

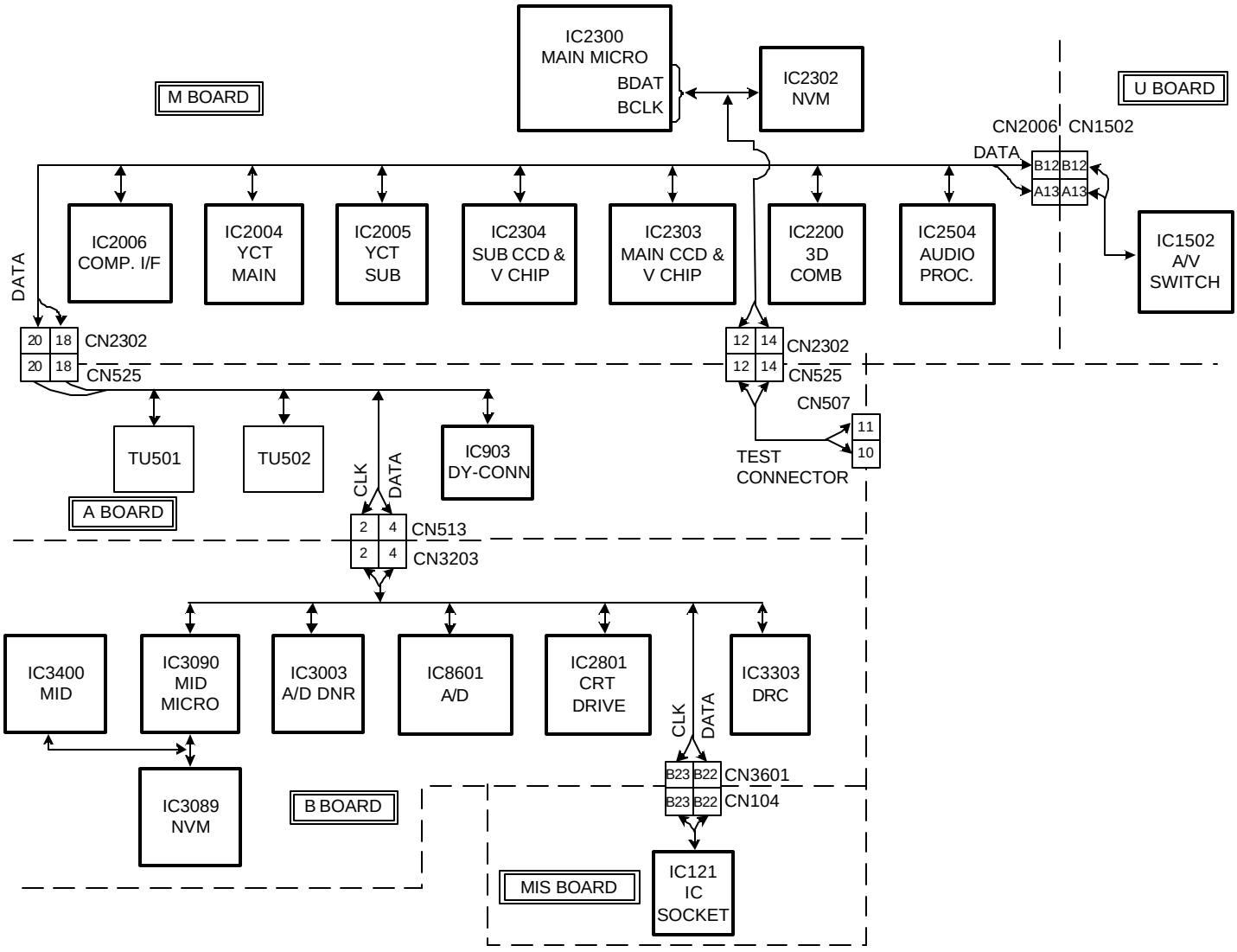


FIGURE 7-1 - DA-4 & DA-4X DATA COMMUNIATIONS DIAGRAM C31P15-7-1 10/7/02

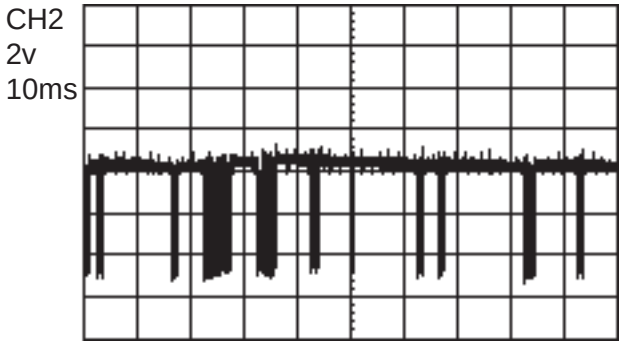
(Reference Figure 7-1)

Main Micro IC2300 generates the clock signal for communications bus network SDAT, SCLK and BDAT, BCLK. Bus network SDAT, SCLK is used to send data to most of the ICs in the TV set.

Network BDAT, BCLK is dedicated communications to the NVM IC2302 on the M-board.

At power ON, the user and deflection data in IC2302 is retrieved by IC2300 using network BDAT, BCLK and passed to the appropriate ICs. Once the ICs receive this data to set their operating parameters, the TV can function.

The data on both bus networks is always present as long as the TV is ON. The data signals can viewed at CN525/pins 20 and 18 (SDAT and SCLK), and CN525/pins 14 and 12 (BDAT and BCLK). The digital signal for all four data looks the same when probing with an oscilloscope (5Vpp digital signal). Reference Waveform 7-1 for the oscilloscope display waveform.



Waveform 7-1
SDAT_SCLK_BDAT_BCLK

Communications bus network DO, CO is only used between the three MID ICs IC3090 (MID Micro), IC3400 (MID IC), and IC3089 (NVM). MID Micro IC3090 communicates with MID IC3400 to retrieve processed data such as the input horizontal frequency and uses it to select video signal paths.

MID Micro IC3090 also communicates with memory IC3089 to set up the multi-picture parameters.

Chapter 8 - DA-4 & DA-4X Audio Circuits

DA-4 and DA-4X Audio Block Diagram

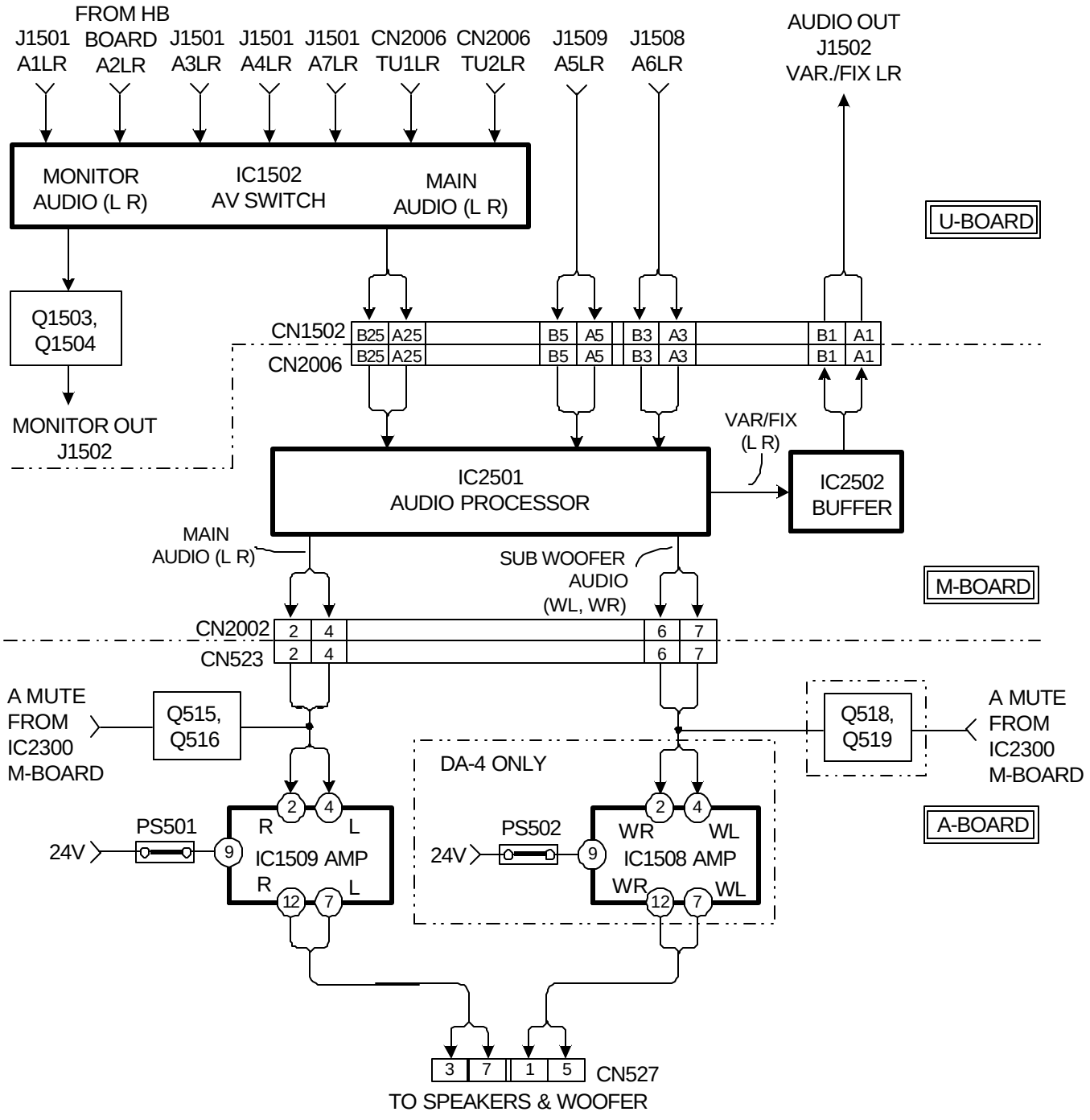


FIGURE 8-1 - DA-4 AND DA-4X AUDIO BLOCK C31P15-8-1 1530 11/4/02

(Reference Figure 8-1)

IC1502 is an Audio/Video Switch (located on the U-board), which selects both audio and video using the I^2C bus from Main Micro IC2300 (not shown). The following audio inputs are available to IC1502:

- Audio 1 – 4
- Audio 7
- TU1 & 2

The selected audio is then sent to the M-board through CN1502/pins B25 & A25 (U-board) and CN2006/pins B25 & A25 (M-board), and applied to the audio processor IC2501. Audio inputs 5 & 6 from the U-board are applied directly to the audio processor IC2501 (U-board) through CN1502/pins B5, A5, B3 and A3 (U-Board), and CN2006/ pins B5, A5, B3 and A3 (U-Board).

The Monitor L/R output also is output from the AV Switch IC1502, applied to Q1504 (buffer) and Q1503 (buffer), and then to J1503.

The audio processor IC2501 takes the main audio input and produces a main L/R output and sub-woofer WL/ WR output (IC2501 also produces the Steady Sound feature). These outputs are then passed to the A-board through CN2002/pins 2, 4, 6 and 7 (M-board) and CN523/pins 2, 4, 6 and 7 (A-board). Next they are applied to the audio amplifies IC509/pins 2 & 4 (Midrange) and IC1508/pins 2 and 4 (Woofer). **Note: IC508 is not used in the DA-4X chassis (projection set). The low frequencies are enhanced in the protection set used the DAC Speaker System. The DAC system uses the Midrange speakers TV cabinet as a low frequency chamber system.**

The VAR/FIX L/R audio is output from Audio Processor IC2501. Audio passes through buffer IC2502 and then to CN2006/pins B1 and A1 (M-board), CN1502/pins B1 and A1, and is finally output at J1502.

Speaker outputs can be viewed at CN527/pins 3, 7, 1 and 5.

Mute transistor Q515, 516, 518 and 519 are activated when the MUTE or Channel buttons are pressed on the remote controller (audio is mute between channels when changing channels). The A-MUTE line will go High, and the transistor will turn ON and send the audio to ground muting the audio output.

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